I-95 South Corridor Transportation Study

Final Report

prepared for:

The Massachusetts Department of Transportation

prepared by:

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in association with:

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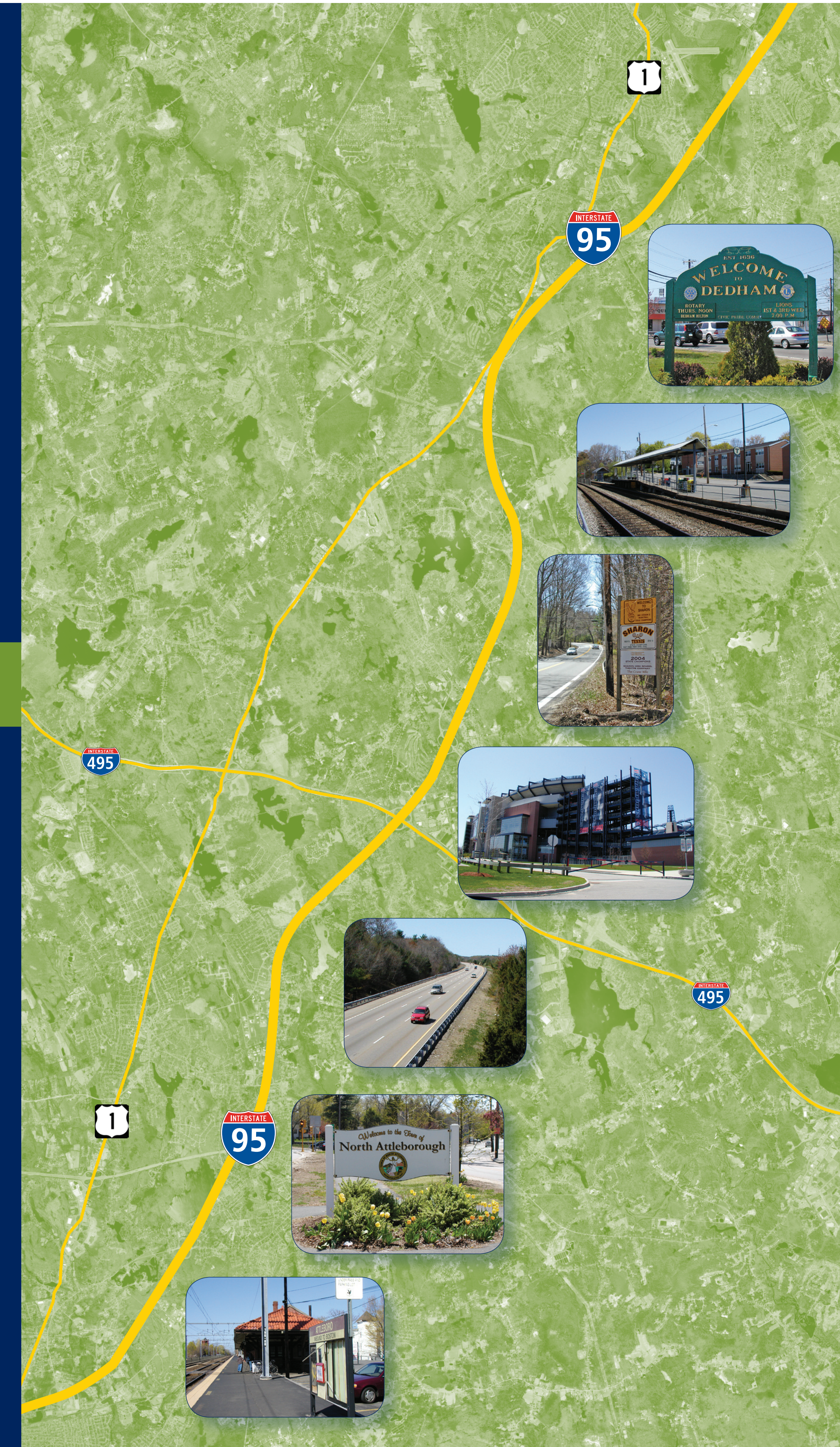

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Study Process and Framework

1.1 Introduction

The I-95 South Corridor Transportation Study is sponsored by the Massachusetts Department of Transportation (MassDOT). It represents a comprehensive 18-month effort to study the transportation network along the Interstate 95 (I-95) corridor from Interstate 93 (I-93)/Route 128 in the north to the Rhode Island State Line in the south. The study area also includes a section of Interstate 495 (I-495) from the Norton/Mansfield town line in the south to the Wrentham/Franklin town line in the north and Route 1 from the Route 109/VFW Parkway intersection on the Boston city line in the north to the Rhode Island/ Massachusetts State Line in the south.

The main focus of the study is to develop a series of recommendations that will improve overall mobility for residents, businesses and visitors. The recommendations must enhance economic opportunities along transportation corridors, improve safety, and improve multimodal connections between neighborhoods and communities.

The study examined and analyzed mobility conditions under existing conditions and under year 2030 conditions. Short-term and long-term mobility recommendations have been developed using both quantitative information from analyses and also qualitative feedback provided by members of the public. The study included the development of a process for on-going coordination of operations and management of the regions multimodal system, including continuous review and implementation of improvement strategies. The recommendations incorporate sustainable growth principles, economic development opportunities, evolving land uses, preservation needs, and multi-modal expansion and connectivity to enhance safe and efficient access for the movement of people and goods from the present through the year 2030.

A Public Outreach Program was an integral component of the study. The study wasguided by two groups – a Working Group and a Study Advisory Group. Members include local municipal representatives, state and federal agency representatives, local advocacy groups, and individuals representing business, the environment, traditionally underserved populations, and freight and rail interests. The members of the Working Group and Study Advisory Group are included in the Appendix of this report. All Study Advisory Group and Public Informational meeting notes are also included in the Appendix of this report.

This report documents all phases of the work efforts for this study and is organized as follows:

- Chapter 1 – Study Process and Framework
- Chapter 2 – Existing Conditions
- Chapter 3 – Future Conditions (year 2030)
- Chapter 4 – Alternatives Development and Analysis
- Chapter 5 – Recommendations

1.2 Study Process

A comprehensive regional transportation planning study involves a well-defined structure and process. The I-95 South Corridor Transportation Study was an 18-month effort organized into six tasks:

- **Task 1: Framework –** Develop the framework for the study, including goals, objectives, study area, evaluation criteria, and the public involvement plan.
- **Task 2: Assess Existing and Future Conditions –** Evaluate existing and anticipated future conditions for the study area, including traffic congestion, safety, environmental issues, community effects, economic development, land use, pedestrians, bicyclists, and transit.
- **Task 3: Alternatives Development –** Identify potential short-term and long-term improvement projects through focused scenario planning workshops, consultation with stakeholders, and consensus-building.
- **Task 4: Alternatives Analysis –** Evaluate all potential improvement projects based on the criteria identified in Task 1 including mobility, safety, environmental effects, land use and economic development, community effects, and cost.
- **Task 5: Recommendations –**Develop a set of short-term and long-term recommendations based on the analysis completed in the previous task.
- **Task 6: Final Report –** Prepare a Final Report for the study which will document the findings from Tasks 1 to 5.

A Public Outreach Plan was integrated throughout the six tasks. Opinions of the Working Group, Study Advisory Group, and public were solicited at every opportunity.

1.3 Study Area

The first step in the study framework development involved defining the study area. The study area, depicted on Figure 1-1, includes:

- I-95 from I-93/Route 128 to the Rhode Island/Massachusetts State Line;
- I-495 from Route 1A to Route 140; and
- Route 1 from the Route 109/Bridge Street intersection on the Boston city line to the Rhode Island/Massachusetts State Line.

The study area boundary was finalized with input from the Working Group and the Study Advisory Group. The twelve municipalities within the study area include Attleboro, Canton, Dedham, Foxborough, Mansfield, North Attleborough, Norwood, Plainville, Sharon, Walpole, Westwood, and Wrentham.

The I-95 and I-495 study area extends to the local roadway system supporting the interstate highway system (which generally includes features approximately 250 feet from the outside edge of the pavement along I-95). This width includes the limits of where potential highway improvements might occur based on the defined needs of the study.

The Route 1 study area includes each of the major signalized intersections along the corridor and other specific areas discussed with the Working Group and Study Advisory Group. For each Route 1 study area intersection, the intersection and a distance of approximately 50 feet from the outside edge of the pavement along Route 1 was studied. This width includes the limits of where potential highway improvements might occur based on the defined needs of the study. Unlike the I-95 and I-495 corridors, Route 1 provides access to a number of local roadways and private developments along its length. Where appropriate, the impacts of these parcels to the Route 1 corridor have also been studied.

The key intersections, freeway segments, transit services, and pedestrian/bicycle networks within the study area were evaluated. Once the study area was defined, the next step in the study framework development involved refining the study goals, objectives, and evaluation criteria.

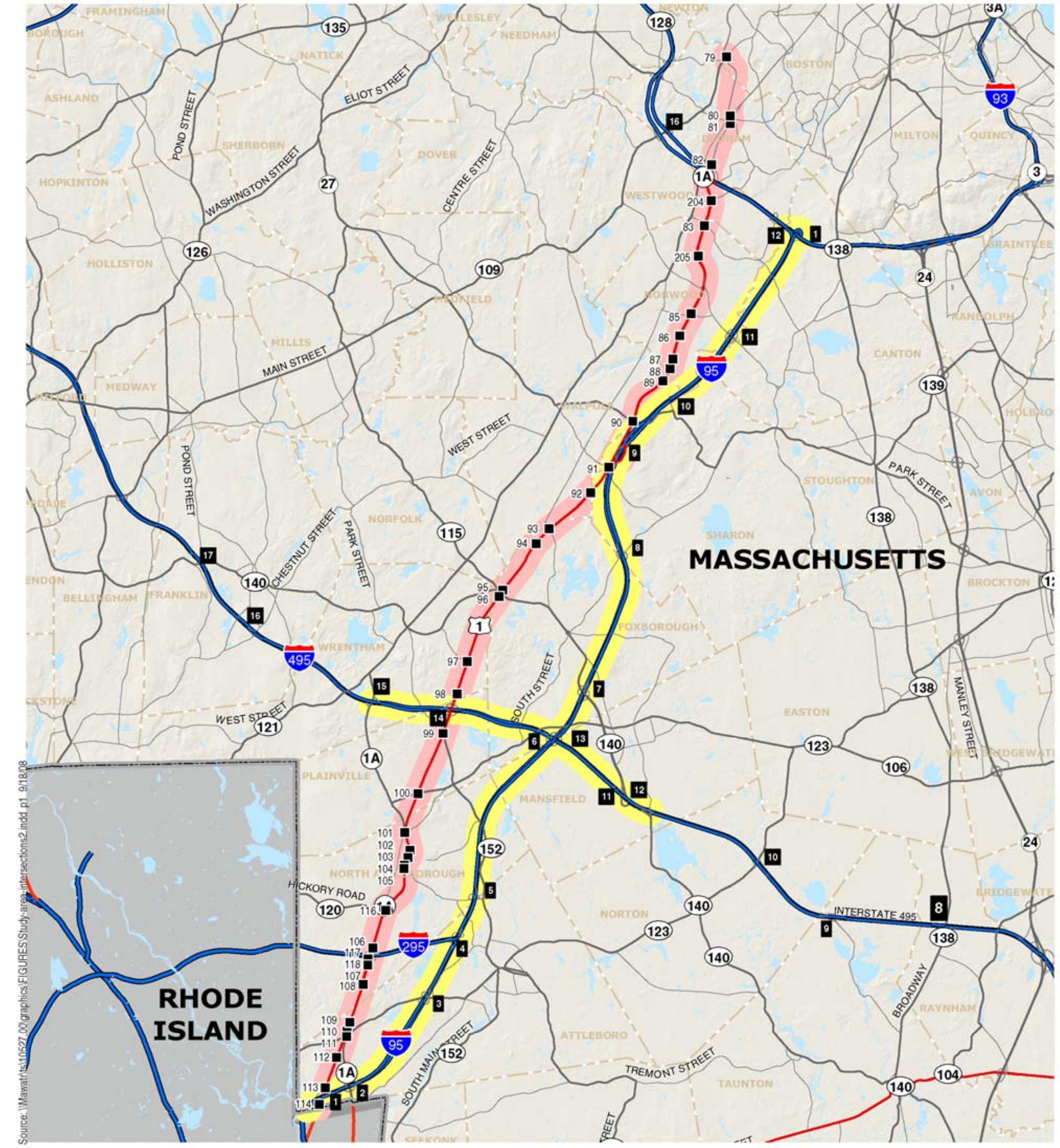
1.4 Study Goals, Objectives, Evaluation Criteria

During the initial months of the study, preliminary goals, objectives, and evaluation criteria were developed and refined in conjunction with the Working Group and Study Advisory Group. Goals define the general intentions and purposes for conducting the study based on the issues that have to be addressed. Objectives describe ways that the goals could be accomplished. The evaluation criteria are used to qualitatively and quantitatively measure how well each alternative meets the stated goal and objectives.

Through coordination with the Working Group and Study Advisory Group, the following goals for the study were developed:

- Improve traffic flow on freeways, ramps and local streets in the study area.
- Improve safety for all modes of transportation within the study area.
- Improve mobility and transportation choice.
- Meet transportation goals while minimizing impacts to the quality of life for area communities.
- Protect and enhance the natural and cultural environment.
- Develop recommendations that can be implemented efficiently.
- The study will continue to be conducted through an open and inclusive process.
- Recommendations should address demonstrated needs.

Table 1-1 summarizes the objectives and evaluation criteria related to each specific goal.



Vanasse Hangen Brustlin, Inc.

Figure 1-1

Study Area

I-95 South Corridor Study

Table 1-1 Study Specific Goals, Objectives, and Evaluation Criteria

GOAL/OBJECTIVE	EVALUATION CRITERIA
GOAL: Improve Traffic Flow on freeways, ramps and local streets in the study area.	
▪ Decrease congestion and reduce delays	▪ Average speeds ▪ Queue lengths at key intersections ▪ Level of service (LOS) at key intersections and links
▪ Improve system reliability	▪ Number of lane changes ▪ Flow rate ▪ Duration and extent of congestion
▪ Minimize local street impacts and relieve impacts of cut through traffic	▪ Changes in forecast traffic volumes on key local streets
GOAL: Improve safety for all modes of transportation within the study area.	
▪ Eliminate/improve locations and situations that pose hazards	▪ Evaluate existing intersection/interchange geometry vs. current design standards ▪ Focus on hot spots from crash records - changes in contributing factors to safety hazards
▪ Ensure that the transportation infrastructure meets current safe design standards	▪ Number of deviations from AASHTO and MassHighway guidelines
GOAL: Improve mobility and transportation choice.	
▪ Explore ways to reduce auto dependency	▪ Potential for programs to reduce auto dependency
▪ Seek ways to improve coordination of existing transit services where possible	▪ Count modal connections, bike and/or pedestrian paths, lanes, racks and other facilities
▪ Explore the provision of expanded public transportation options in the study area	▪ Number of routes, ridership, frequency of services, reductions in bus/rail delays
▪ Explore ridesharing options and High Occupancy Vehicle (HOV) use	▪ Feasibility for expanding ridesharing ▪ Feasibility/effectiveness of HOV lanes
▪ Explore opportunities for Intelligent Transportation Systems (ITS)	▪ Potential for ITS enhancements to improve regional and local access
GOAL: Meet transportation goals while minimizing impacts to the quality of life for area communities.	
▪ Minimize noise impacts on adjacent residences and other sensitive receptors	▪ Qualitative evaluation of noise impacts on adjacent properties
▪ Minimize visual impacts on the communities and enhance the visual environment, where possible	▪ Description of changes in views at representative locations
▪ Relieve impacts of cut through traffic on neighborhoods and business districts	▪ Qualitative indirect effects of property values ▪ Qualitative indirect effects of revenue & jobs
▪ Minimize residential and business property takings	▪ Number of full and partial takings

Table 1-1 Study Specific Goals, Objectives, and Evaluation Criteria (cont.)

GOAL/OBJECTIVE	EVALUATION CRITERIA
GOAL: Meet transportation goals while minimizing impacts to the quality of life for area communities. (cont.)	
▪ Minimize negative economic effects to tax bases, and seek opportunities to enhance local and regional economic activity where possible	▪ Review of Community Master Plans
▪ Maintain consistency with community land use visions	▪ Review of Community Master Plans
▪ Maintain community and business district connections and access, including automobile, truck, emergency vehicle, bicycle and pedestrian access, and make improvements where possible	▪ Review of Community Master Plans, specifically town's transportation master plans
▪ Avoid inequitable distribution of environmental risks, hazards, and burdens	▪ Qualitative indirect effects on adjacent minority and disadvantaged populations
GOAL: Protect and enhance the natural and cultural environment.	
▪ Protect wetlands and water bodies	▪ Number of wetlands affected and square feet of encroachment
▪ Protect wildlife habitats, particularly habitats that support threatened or endangered species	▪ Number of habitats affected and square feet of encroachment
▪ Maintain or improve regional and local air quality	▪ Within regional emissions targets (macro analysis)
▪ Protect historic/archeological resources	▪ Positive or negative impact to historical/archeological resources
▪ Protect parkland/conservation land	▪ Positive or negative impact to parkland/conservation land
▪ Minimize impact to, and properly address as needed, areas containing land contaminated by hazardous materials	▪ Description of effect (positive or negative) on any such areas and measures to appropriately address
▪ If impacts cannot be avoided, minimize them to the greatest extent possible	▪ Mitigation measures for selected alternative(s)
GOAL: Develop recommendations that can be implemented efficiently.	
▪ Minimize construction impacts (to traffic flow, the surrounding quality of life and natural environment)	▪ Description, severity, and duration of construction impacts and measures to mitigate
▪ Identify solutions that are cost-effective in the context of state transportation planning	▪ Conceptual cost estimates
▪ Identify solutions that meet the MassHighway Design Manual Criteria	▪ Number of deviations from AASHTO and MassHighway guidelines
▪ Identify solutions that meet criteria for federal funding	▪ Number of deviations from AASHTO and MassHighway guidelines
▪ Identify solutions that include both short-term and long-term actions to improve traffic flow and safety	▪ Improved level of service, reduced VMT/VHT to 2030 ▪ Mode share, trip distribution by roadway functional classification

Table 1-1 Study Specific Goals, Objectives, and Evaluation Criteria (cont.)

GOAL/OBJECTIVE	EVALUATION CRITERIA
GOAL: The study will continue to be conducted through an open and inclusive process.	
▪ The input of the Task Force and the public will be documented and thoroughly considered at every stage of the study	▪ Documentation of meetings, public outreach meetings at appropriate stages, and responses to questions raised
▪ MassDOT and the Study Advisory Group will attempt to reach reasonable consensus on study recommendations	▪ Form a diverse Study Advisory Group for the study ▪ Encourage consensus
▪ Keep adjacent communities informed and consulted throughout study	▪ Hold outreach meetings at key stages of the process
▪ Keep the general public informed throughout process	▪ Hold outreach meetings at key stages of the process ▪ Provide regular updates to the website
▪ Provide ample opportunities for general public to comment throughout the study	▪ Provide multiple comment options for study process
GOAL: Recommendations should address demonstrated needs.	
▪ The needs - such as safety and traffic flow criteria - will be quantified or qualified as clearly as possible	▪ Documentation of analyses and recommendations throughout the study (Task 1 through Task 6)
▪ Provide justification for any additional recommended actions over and above what analyses show is necessary	▪ Documentation of analyses and recommendations throughout the study (Task 1 through Task 6)

After defining the study area and developing the goals, objectives, and evaluation criteria, the next step in the study framework development involved developing and refining a public outreach plan to ensure that the study process is transparent to the public and that the recommendations are thoroughly reviewed.

1.5 Public Outreach Plan

Public outreach and involvement were key components of each study task. An extensive Public Outreach Plan was implemented to ensure an open, transparent, and collaborative study process. The Public Outreach Plan included public informational meetings, scenario planning workshops, community outreach meetings, Working Group and Study Advisory Group meetings, and small group focus sessions – all occurring at key decision making points to engage the public and stakeholders and provide a forum to solicit opinions and feedback.

To further ensure constant information exchange, a study website was established to highlight information including scope, study area, schedule, progress, and contacts for more information.

The study website (www.mass.gov/i95southinfo) served as an additional means for public and stakeholder comments. Online comment forms were provided on the website for anyone to provide feedback at any time throughout the study. All meeting notes, presentation materials, and study reports were posted on the study website. Additionally, a study newsletter was developed to communicate study milestones and next steps. The newsletters are included in the Appendix to this report. Table 1-2 summarizes the overall study outreach program.

Table 1-2 Study Outreach Program

Event	Date	Topic
Working Group Meeting 1	April 30, 2008	Study kick-off; review study areas, goals/objectives, evaluation criteria
SAG Meeting 1	June 11, 2008	Study kick-off; review study areas, goals/objectives, evaluation criteria
Community Outreach Meeting 1	September 25, 2008	Introduce study; solicit feedback on transportation issues
Community Outreach Meeting 2	September 30, 2008	Introduce study; solicit feedback on transportation issues
Community Outreach Meeting 3	October 1, 2008	Introduce study; solicit feedback on transportation issues
Working Group Meeting 2	January 14, 2009	Review findings of draft Chapter 2 Existing Conditions
SAG Meeting 2 – Northern Section	January 26, 2009	Review findings of draft Chapter 2 Existing Conditions
SAG Meeting 2 – Southern Section	January 29, 2009	Review findings of draft Chapter 2 Existing Conditions
Working Group Meeting 3	May 6, 2009	Review findings of draft Chapter 3 Future Conditions
SAG Meeting 3	May 20, 2009	Review findings of draft Chapter 3 Future Conditions; discuss the selection of ten Route 1 intersections for further study
Public Informational Meeting 1 – Southern Section	June 16, 2009	Study kick-off; review study area, goals/objectives, evaluation criteria; review findings of Chapter 2 Existing Conditions and Chapter 3 Future Conditions
Public Informational Meeting 1 – Northern Section	June 17, 2009	Study kick-off; review study area, goals/objectives, evaluation criteria; review findings of Chapter 2 Existing Conditions and Chapter 3 Future Conditions
Alternatives Development Meeting – MassDOT Staff	July 16, 2009	Develop range of alternatives for study area interchanges and intersections
Alternatives Development Meeting – Working Group Meeting 4	July 21, 2009	Develop range of alternatives for study area interchanges and intersections
Working Group Meeting 5	October 14, 2009	Alternatives analysis and potential recommendations discussion
SAG Meeting 4	October 29, 2009	Alternatives analysis and potential recommendations discussion
Community Outreach Meeting 4	November 17, 2009	Solicit feedback on potential recommendations
Community Outreach Meeting 5	November 18, 2009	Solicit feedback on potential recommendations
Community Outreach Meeting 6	November 21, 2009	Solicit feedback on potential recommendations
Public Informational Meeting 2 – Southern Section	December 15, 2009	Review alternatives development and analysis and discuss potential recommendations
Public Informational Meeting 2 – Northern Section	December 16, 2009	Review alternatives development and analysis and discuss potential recommendations

2

Existing Conditions

This chapter describes the existing conditions within the study area. Various sections of this chapter present basic demographics of the region, traffic volumes and operations, pedestrian and bicycle accommodations, environmental resources, land use, transit services, safety, travel patterns, and a summary of the current transportation infrastructure deficiencies and needs.

The primary purpose of this study is to identify transportation issues along the corridors and to recommend improvement alternatives for addressing these issues. This chapter documents many of the design and operational issues for the corridors and presents the framework for assessing expected future conditions without improvements as well as potential alternatives for addressing these defined issues.

2.1 Study Area Demographics

This section provides an overview of the transportation-related demographics for the study area communities. These include population, employment, and other socio-economic data. This demographic data will help identify activity nodes within the study area and assist in focusing the needs assessment for future sections of the report and recommendations.

2.1.1 Population

The I-95 South Corridor area had about 230,000 residents in 1990 and more than 253,000 residents in 2000. This represents an approximately 10 percent increase over ten years. Table 2-1 displays population and employment by jurisdiction and compares 1990 and 2000 census data to show regional growth patterns within the study area. Attleboro was the most populated municipality within the study area with about 42,000 residents in 2000. Other municipalities with more than 25,000 residents in 2000 include North Attleborough and Norwood.

Table 2-1 Population and Employment Totals by Jurisdiction

	Population			Labor Force		
Community	1990	2000	Percent Growth	1990	2000	Percent Growth
Attleboro	38,383	42,068	9.6%	21,434	22,914	6.9%
Canton	18,530	20,775	12.1%	10,535	10,949	3.9%
Dedham	23,782	23,464	-1.3%	13,039	12,104	-7.2%
Foxborough	14,637	16,246	11.0%	8,416	8,935	6.2%
Mansfield	16,568	22,414	35.3%	9,748	11,995	23.1%
North Attleborough	25,038	27,143	8.4%	14,935	15,495	3.7%
Norwood	28,700	28,587	-0.4%	16,391	15,511	-5.4%
Plainville	6,871	7,683	11.8%	4,002	4,423	10.5%
Sharon	15,517	17,408	12.2%	8,771	9,130	4.1%
Walpole	20,212	22,824	12.9%	11,312	11,932	5.5%
Westwood	12,557	14,117	12.4%	6,781	6,715	-1.0%
Wrentham	9,006	10,554	17.2%	4,652	5,400	16.1%
Total	229,801	253,283	10.2%	130,016	135,503	4.2%

Mansfield, which is located mid-way along the I-95 corridor, was the fastest growing community, experiencing a 35 percent increase in population. Dedham and Norwood, two communities at the north end of the corridor, experienced slight decrease in population. All other communities, except Attleboro and North Attleborough, had growth rates greater than the area average of 10.2 percent.

2.1.2 Employment

As shown in Table 2-1, the I-95 South Corridor area had 135,500 residents in the labor force in 2000. This was about 4 percent higher than the labor force of 130,000 in 1990. The population of the area grew at two and one-half times the rate of growth in employment between 1990 and 2000. Attleboro had the largest labor force with almost 23,000 employed residents. The next two highest were North Attleborough and Norwood with about 15,500 each. As with population, Mansfield experienced the highest growth rate in its labor force at 23 percent while Norwood and Dedham experienced declines of 5.4 and 7.2 percent, respectively.

2.1.3 Socio-Economic Demographics

The following sections present Census data related to age, income, and car ownership for persons living within the I-95 South Corridor area. Overall, there were several jurisdictions that had high concentrations of transit-dependent populations in 2000. Table 2-2 presents a summary of transit-dependent populations by jurisdiction. Populations most dependent on transit include seniors, young people, low-income households and households that do not own an automobile. All the communities had a high or medium concentration of at least one of the transit dependent populations. Six communities had a high concentration of seniors or young people and one (Attleboro) had a high number of low-income households. None of the communities was rated as having a high number of zero-auto households, indicating that car ownership in the region is commonplace amongst the various communities.

Table 2-2 Transit-Dependent Populations by Jurisdiction

Community	Senior Population	Youth Population	Lower Income Households	Zero-auto Households
Attleboro	Medium	Medium	High	Medium
Canton	High		Medium	Medium
Dedham	High		Medium	Medium
Foxborough	Medium	Medium	Medium	
Mansfield		High	Medium	
North Attleborough		Medium	Medium	Medium
Norwood	High		Medium	Medium
Plainville	Medium	Medium	Medium	
Sharon		High		
Walpole	Medium	Medium		
Westwood	High	Medium		Medium
Wrentham	Medium	Medium		

Age

The I-95 South Corridor area contained about 28,500 persons age 65 and over in 1990, approximately 12 percent of the total population. In 2000, there were almost 34,000 persons age 65 and over, which was approximately 13 percent of the 2000 total population. The senior population in the area grew by 18.7 percent, almost twice the 10.2 percent growth in the total population.

Table 2-3 displays the senior population by jurisdiction and compares 1990 and 2000 census data to show growth patterns within the study area. In 2000, Attleboro and Norwood had the largest senior populations with 5,400 and 5,000, respectively. The community with the largest increase in its senior population was Walpole with over 1,000 additional seniors being added between 1990 and 2000, for an increase of 47 percent. Westwood had the largest share of seniors with 19.1 percent of its population age 65 and over.

Table 2-3 Senior[1] Population by Jurisdiction

	1990		2000		Increase	
Community	Population	Percent of Total	Population	Percent of Total	Number	Percent
Attleboro	4,627	12.1%	5,422	12.9%	795	17.2%
Canton	2,598	14.0%	3,505	16.9%	907	34.9%
Dedham	3,737	15.7%	3,905	16.6%	168	4.5%
Foxborough	1,572	10.7%	1,933	11.9%	361	23.0%
Mansfield	1,178	7.1%	1,426	6.4%	248	21.1%
North Attleborough	2,425	9.7%	2,622	9.7%	197	8.1%
Norwood	4,757	16.6%	5,022	17.6%	265	5.6%
Plainville	850	12.4%	928	12.1%	78	9.2%
Sharon	1,547	10.0%	1,897	10.9%	350	22.6%
Walpole	2,242	11.1%	3,293	14.4%	1,051	46.9%
Westwood	2,009	16.0%	2,701	19.1%	692	34.4%
Wrentham	1,008	11.2%	1,228	11.6%	220	21.8%
Total	28,550	12.4%	33,882	13.4%	5,332	18.7%

1. Age 65 and over

In addition, the I-95 South Corridor area contained about 53,700 persons under age 18 in 1990, which was approximately 23 percent of the total population. In 2000, the study area contained about 65,300 persons under age 18, which was almost 26 percent of the total population. The youth population of the region increased 21.7 percent – or more than twice the increase of the total area population.

Table 2-4 displays youth population by jurisdiction and compares 1990 and 2000 census data to show growth patterns within the study area. As the most populous community in the area, Attleboro not only had the largest senior population, it also had the largest youth population with 10,700 people under age 18. The next largest youth populations were in North Attleborough and Mansfield with 7,300 and 7,000 young people, respectively. Mansfield not only had the third largest youth population, it also had the largest increase between 1990 and 2000 (over 2,500 or 56 percent) and the highest percentage share (31.4 percent) of population under 18 years of age.

Table 2-4 Youth[1] Population by Jurisdiction

Community	1990 Population	1990 Percent of Total	2000 Population	2000 Percent of Total	Increase Number	Increase Percent
Attleboro	9,604	25.0%	10,674	25.4%	1,070	11.1%
Canton	3,972	21.4%	4,906	23.6%	934	23.5%
Dedham	4,771	20.1%	5,208	22.2%	437	9.2%
Foxborough	3,475	23.7%	4,298	26.5%	823	23.7%
Mansfield	4,504	27.2%	7,028	31.4%	2,524	56.0%
North Attleborough	6,301	25.2%	7,291	26.9%	990	15.7%
Norwood	5,470	19.1%	5,935	20.8%	465	8.5%
Plainville	1,567	22.8%	1,962	25.5%	395	25.2%
Sharon	4,190	27.0%	5,256	30.2%	1,066	25.4%
Walpole	4,808	23.8%	5,899	25.8%	1,091	22.7%
Westwood	2,717	21.6%	3,927	27.7%	1,210	44.5%
Wrentham	2,282	25.3%	2,935	27.8%	653	28.6%
Total	53,661	23.4%	65,319	25.8%	11,658	21.7%

1. Under age 18.

Commuting Patterns between Jurisdictions

Table 2-5 displays commuting patterns between communities within the I-95 South Corridor area and between the communities in the area and outside the area, including Boston. All commuting patterns were collected from the U.S. Census 2000 Journey to Work data.

The most significant population and employment densities were located in Boston. Other areas that were densely populated and had a large work force included communities closer to Boston and Attleboro and North Attleborough. I-95 and Route 1 serve as north-south commuting corridors to work locations. In addition, I-295, I-495 and Route 128 are major east-west corridors in the region.

As shown in Table 2-5, Boston residents made the largest number (192,503) of work trips from the region. Other than trips made by Boston residents, Attleboro residents made the highest number (13,086) of commute trips within the study area. Fifty-one percent of Attleboro's residents worked within Attleboro. More than 1,300 residents commuted to Boston as well as to North Attleborough. Mansfield and Norwood also received more than 500 commuters per day from Attleboro.

Table 2-5 Commuting Patterns between Jurisdictions in the Study Area

Place of Residence	Place of Work: Attleboro	Boston	Canton	Dedham	Foxborough	Mansfield	North Attleborough	Norwood	Plainville	Sharon	Walpole	Westwood	Wrentham	Out of Study Area	Total
Attleboro	6,696	1,357	213	104	490	882	1,638	525	254	234	229	140	324	8,454	21,540
Boston	125	184,954	1,433	2,017	245	174	53	1,769	66	158	332	1,092	85	85,960	278,463
Canton	18	2,739	2,141	226	66	72	-	392	8	78	77	249	22	4,352	10,440
Dedham	6	3,557	201	2,296	23	31	26	598	6	33	99	272	16	4,248	11,412
Foxborough	87	1,210	219	166	1,578	396	110	585	82	203	395	141	150	3,203	8,525
Mansfield	215	1,815	289	146	482	2,128	168	527	55	181	122	138	115	4,938	11,319
North Attleborough	1,369	801	212	123	458	558	3,021	425	589	122	359	194	401	6,036	14,668
Norwood	17	2,960	480	555	134	96	13	3,608	-	147	363	654	81	5,709	14,817
Plainville	225	339	62	32	129	180	235	185	378	22	201	29	336	1,806	4,159
Sharon	29	1,924	428	184	119	66	30	542	21	1,360	226	95	8	3,782	8,814
Walpole	88	2,260	240	347	124	53	10	1,148	21	158	2,167	280	78	4,432	11,406
Westwood	9	1,886	134	256	29	13	7	498	-	17	55	1,037	25	2,528	6,494
Wrentham	89	382	154	46	232	116	92	361	67	55	193	102	925	2,405	5,219
Out of Study Area	11,925	314,371	13,764	7,274	4,528	6,499	5,627	11,564	1,366	2,128	3,835	6,630	2,702	-	392,213
Total	20,898	520,555	19,970	13,772	8,637	11,264	11,030	22,727	2,913	4,896	8,653	11,053	5,268	137,853	799,489

In addition, Boston was the jurisdiction that generated the largest number of work trips (206,184) from commuters in the study area. Other than Boston, Norwood was the jurisdiction that generated the highest number (11,163) of work trips in the study area. Almost 40 percent of Norwood employees resided in Norwood. In addition, large numbers (at least 1,000 per day) of Norwood employees traveled from Boston and Walpole. Attleboro, Dedham, Foxborough, Mansfield, and Sharon each contributed more than 500 trips per day into Norwood.

Many commuting patterns are a result of proximity, with workers generally preferring shorter commutes. Thus, there were many intra-jurisdictional trips in 2000. 184,954 residents of Boston worked in Boston and 6,696 residents of Attleboro worked in Attleboro, the two highest intra-jurisdictional trip totals. In addition, the following jurisdictions had high numbers (more than 2,000) of residents that worked within the community:

- Canton – 2,141
- Dedham – 2,296
- Mansfield – 2,128
- North Attleborough – 3,021
- Norwood – 3,608
- Walpole – 2,167

These residents, for the most part, work and live in the same community. For this reason, these commuters most likely stayed on the local roadway systems and didn't travel onto the

Interstate highway system. This is one of the underlying principles in smart growth and where possible, these types of trips should be encouraged and increased.

2.2 Land Use

The I-95, I-495, and Route 1 corridors all present various and differing land uses along their lengths. Using MassGIS information, these land uses were identified and broken down into the following various categories and are shown in Figures 2-1 through 2-7.

- Crop Lands & Pastures
- Forest
- Non-Forested Wetlands
- Mining
- Open Land
- Generic Recreation
- Residential
- Commercial
- Industrial
- Urban Open Space
- Transportation Uses
- Waste Disposal, and
- Wooded Perennial lands

While each community has specific zoning in place to guide development and land use decisions, knowing the current land use helps to understand the context for any proposed changes to the highway network.

2.3 Transit and Alternative Transportation

This section documents transit options, including commuter rail and bus, and bicycle and pedestrian accommodations within the study area. Two main transit services providing regular service to the communities within the study area are the Massachusetts Bay Transportation Authority (MBTA) and the Greater Attleboro Taunton Regional Transit Authority (GATRA).

2.3.1 Transit Services

The MBTA provides commuter rail and bus service into and out of the greater Boston area. There are two commuter rail lines that traverse the study area. One is the Providence/Stoughton line, which has stops in Attleboro, Mansfield, Sharon, Canton, and Westwood. The other is the Franklin line, which has stops in Walpole, Norwood, Westwood, Dedham, and Boston. In addition to commuter rail, the MBTA also provides bus service to study area municipalities including Walpole, Norwood: MBTA also provides paratransit to Westwood, Dedham, Boston and Canton.

The other transit service provider in the I-95 South Corridor area is GATRA, which provides bus services to 26 area communities, including the towns of Attleboro, North Attleborough, Plainville, Mansfield, Foxborough and Wrentham. Their services include fixed-route bus service, paratransit (Dial-A-Ride) service for people with disabilities and senior citizens, Medicaid and Human Service transportation, commuter rail, and bicycling.

Figure 2-8 displays the current transit service routes within in the I-95 South area at the time of this reports publishing.

2.3.2 Bicycle and Pedestrian Mobility

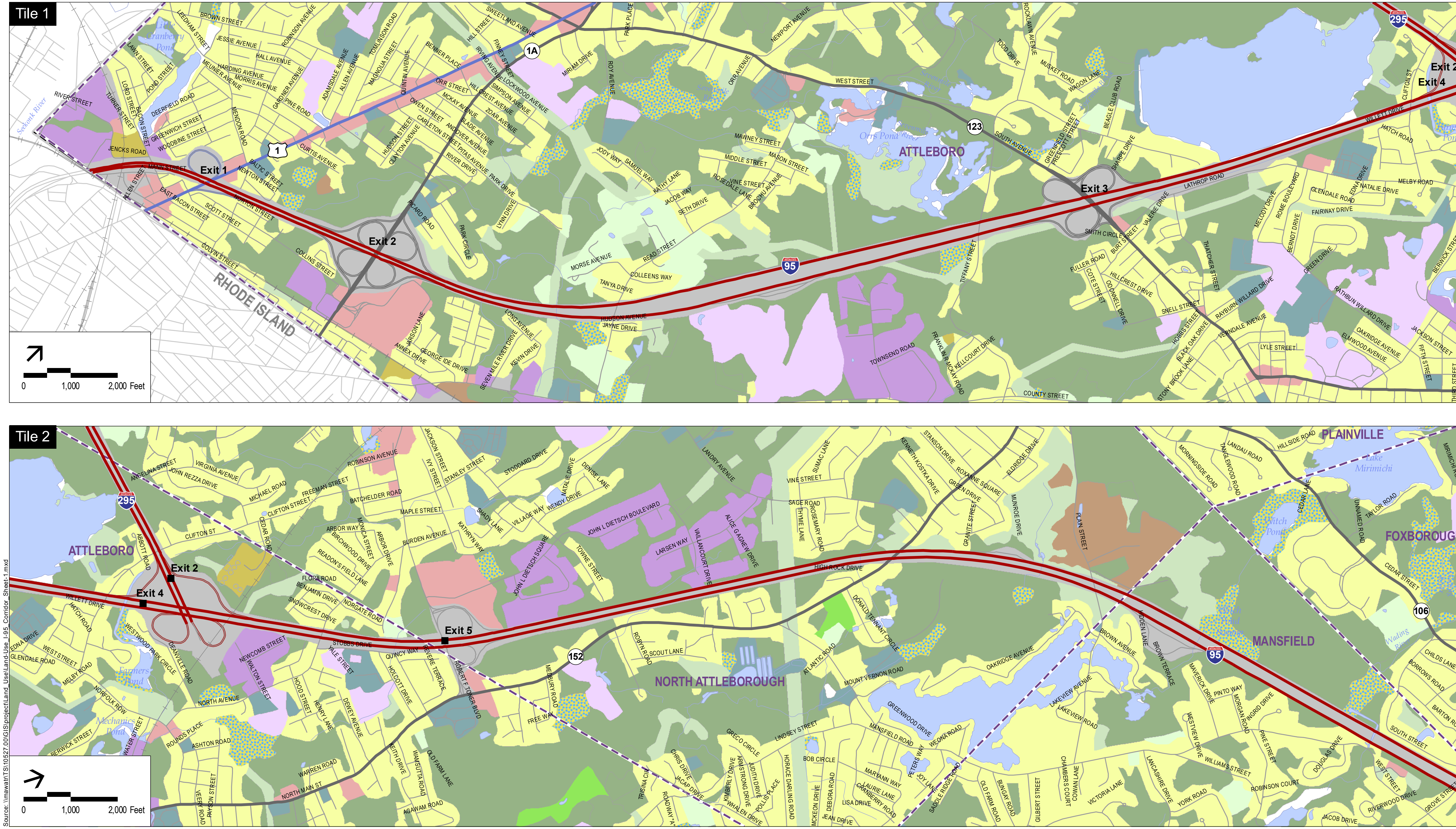
Bicycle mobility is an important component of the transportation system in the study area. While a significant portion of the study area focuses on the mainline I-95 corridor, which has no bicycle accommodations, local streets provide some options for bicyclists.

Low income, youth, senior and zero-auto household populations often have limited access to motor vehicles, and walking and bicycling are viable and necessary means of transportation. As noted earlier, all the communities had a high or medium concentration of at least one of the transit dependent populations. Attleboro, Mansfield, Canton, Dedham, Norwood and Sharon all have high proportions seniors or young people, and Attleboro has a high number of low-income households. These populations could benefit from improvements to the bicycle and pedestrian systems.

Walking and bicycling are especially useful for shorter trips (less than five miles). They can be use used for commuting, errands, and recreational purposes. As described earlier in the commuting patterns of the transit mobility analysis, there were many workers who lived and worked in the same community in 2000. These are trips that, because of their short distance, could be made by walking or bicycling instead of a motor vehicle. The following jurisdictions had high numbers (more than 2,000) of residents that worked within the community. These jurisdictions and their residents could benefit from improvements to the pedestrian and bicycle system.

- Attleboro;
- Canton;
- Dedham;
- Mansfield;
- North Attleborough;
- Norwood; and
- Walpole.

The *Massachusetts Statewide Bicycle Transportation Plan*, completed in September 2008, is the statewide resource for bicycle planning in Massachusetts. This plan does not highlight any particular future projects or improvements in the I-95 South Corridor study area. The Metropolitan Area Planning Commission's *Regional Bike Plan*, completed in 2007, focuses on transit connections and amenities to allow bike / transit connections. However, as with the *Massachusetts Statewide Bicycle Transportation Plan,* there are no specific projects or improvements identified in the study area.

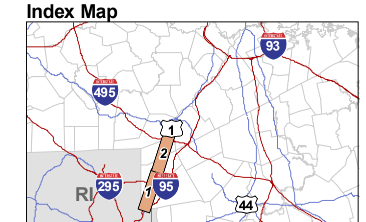


Source: \\mawal\TS\10527.00\GIS\project\Land_Use\Land-Use_I-95_Corridor_Sheet-1.mxd

Legend

Crop Land and Pasture	Mining	Residential	Urban Open	Woody Perennial
Forest	Open Land	Commercial	Transportation	
Non-Forested Wetland	Generic Recreation	Industrial	Waste Disposal	

Index Map



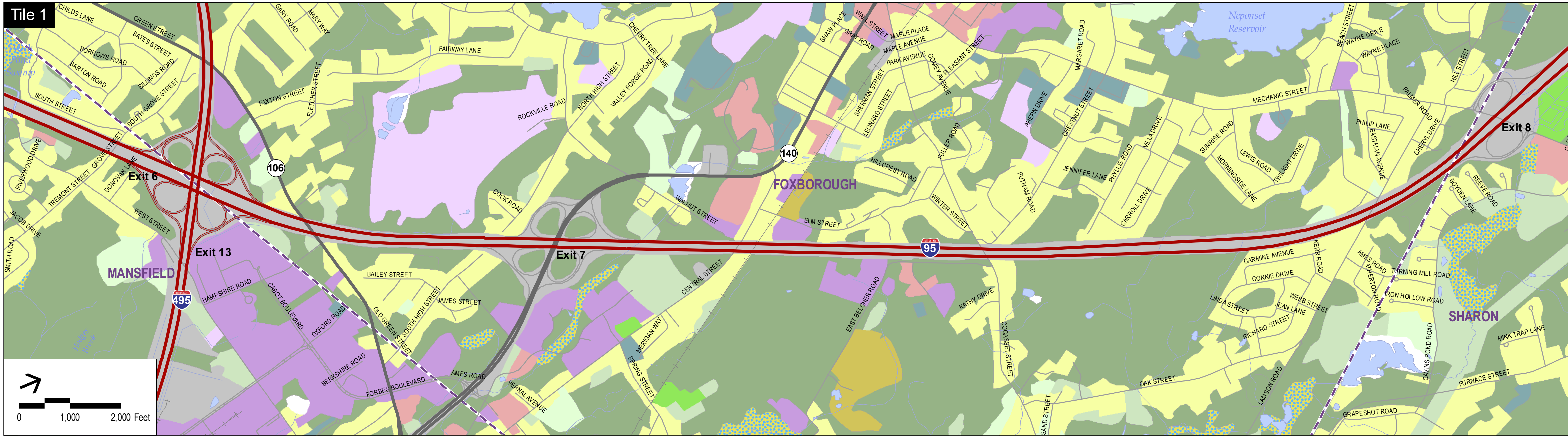
Vanasse Hangen Brustlin, Inc.

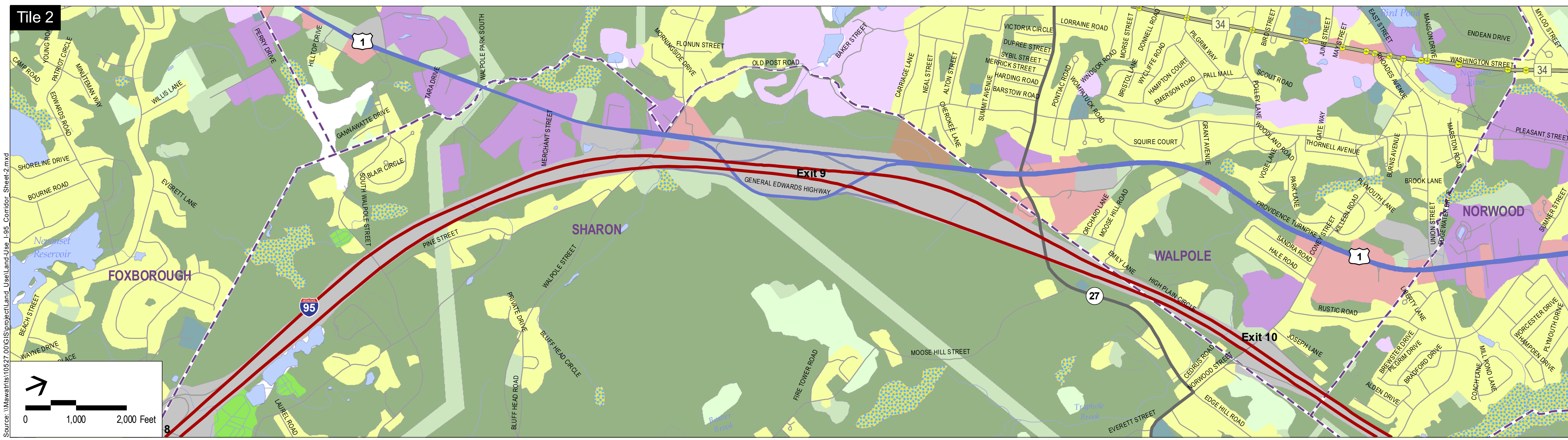
Figure 2-1

I-95 Corridor
Land Use

I-95 Corridor Study

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs





Source: \\Mawantst\10527.00\GIS\project\Land Use\Land-Use_I-95_Corridor_Sheet-2.mxd

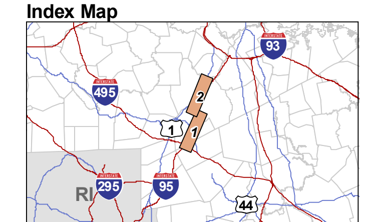
massDOT
Massachusetts Department of Transportation

Legend

- Crop Land and Pasture
- Forest
- Non-Forested Wetland
- Mining
- Open Land
- Generic Recreation
- Residential
- Commercial
- Industrial
- Urban Open
- Transportation
- Waste Disposal
- Woody Perennial

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Index Map



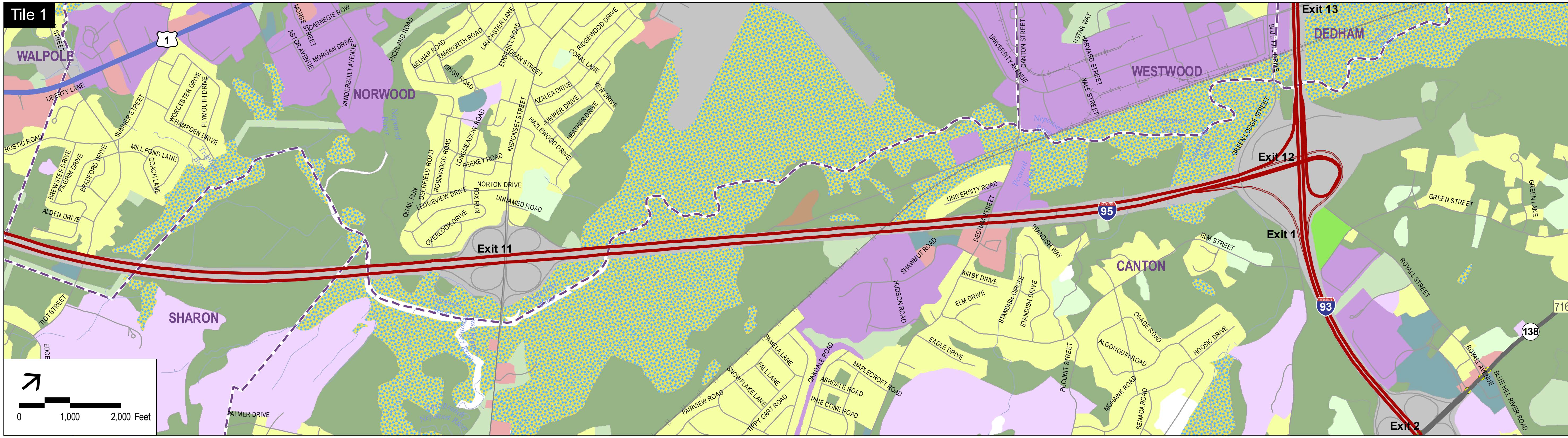
Vanasse Hangen Brustlin, Inc.

Figure 2-2

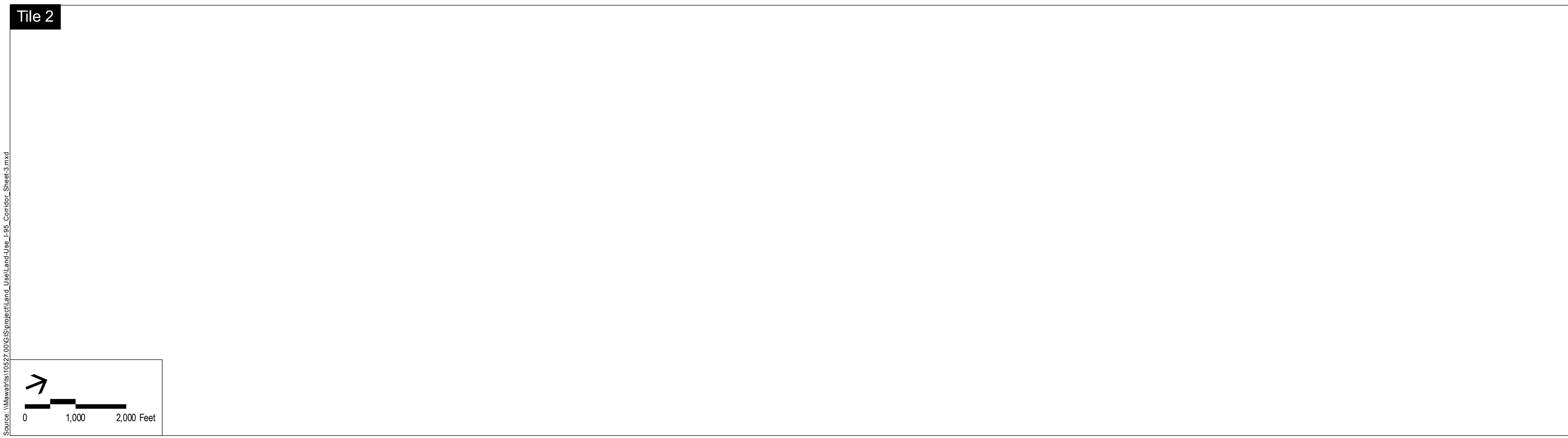
I-95 Corridor
Land Use

I-95 Corridor Study

Tile 1



Tile 2



Source: \\Mawaltrs\10527.00\GIS\project\Land_Use\Land-Use_I-95_Corridor_Sheet-3.mxd

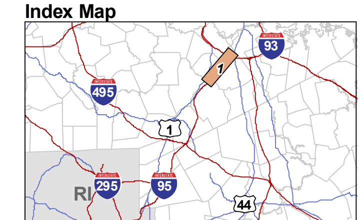
Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

Legend

- Crop Land and Pasture
- Forest
- Non-Forested Wetland
- Mining
- Open Land
- Generic Recreation
- Residential
- Commercial
- Industrial
- Urban Open
- Transportation
- Waste Disposal
- Woody Perennial

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Index Map

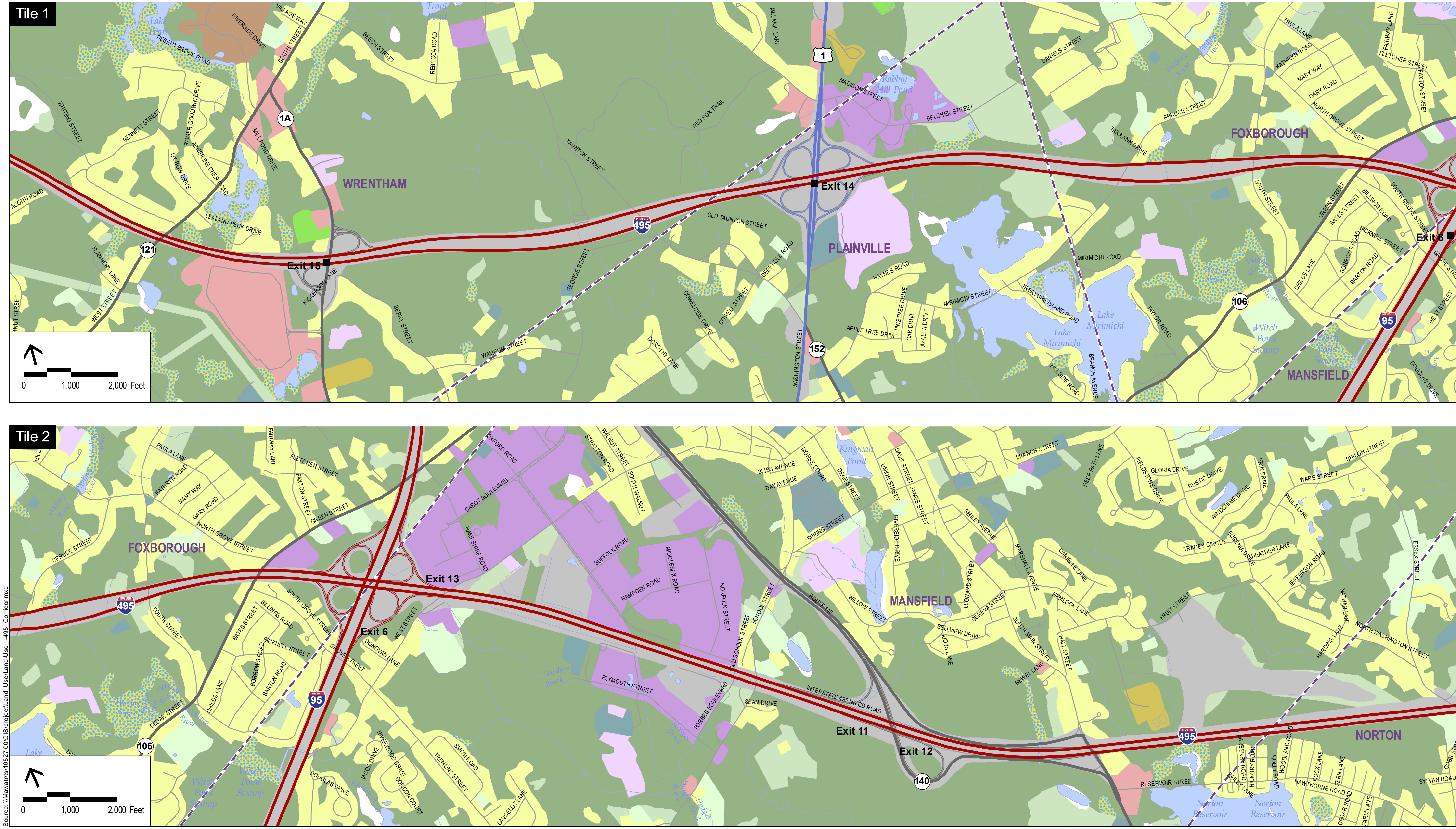


Vanasse Hangen Brustlin, Inc.

Figure 2-3

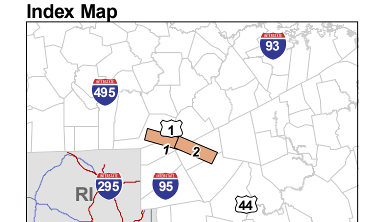
I-95 Corridor
Land Use

I-95 Corridor Study



Source: \\Mawantfs\10527.00\GIS\project\Land_Use\Land-Use_I-495_Corridor.mxd

Index Map



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Massachusetts Department of Transportation

Legend

Crop Land and Pasture	Mining	Residential	Urban Open	Woody Perennial
Forest	Open Land	Commercial	Transportation	
Non-Forested Wetland	Generic Recreation	Industrial	Waste Disposal	

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Vanasse Hangen Brustlin, Inc.

Figure 2-4

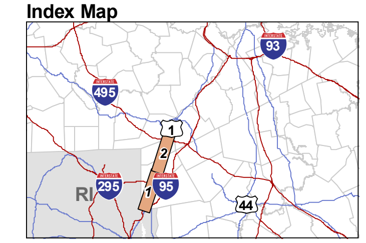
I-495 Corridor
Land Use

I-95 Corridor Study

Legend

- Municipal Boundaries
- Crop Land and Pasture
- Forest
- Non-Forested Wetland
- Mining
- Open Land
- Generic Recreation
- Residential
- Commercial
- Industrial
- Urban Open
- Transportation
- Waste Disposal
- Woody Perennial

Index Map



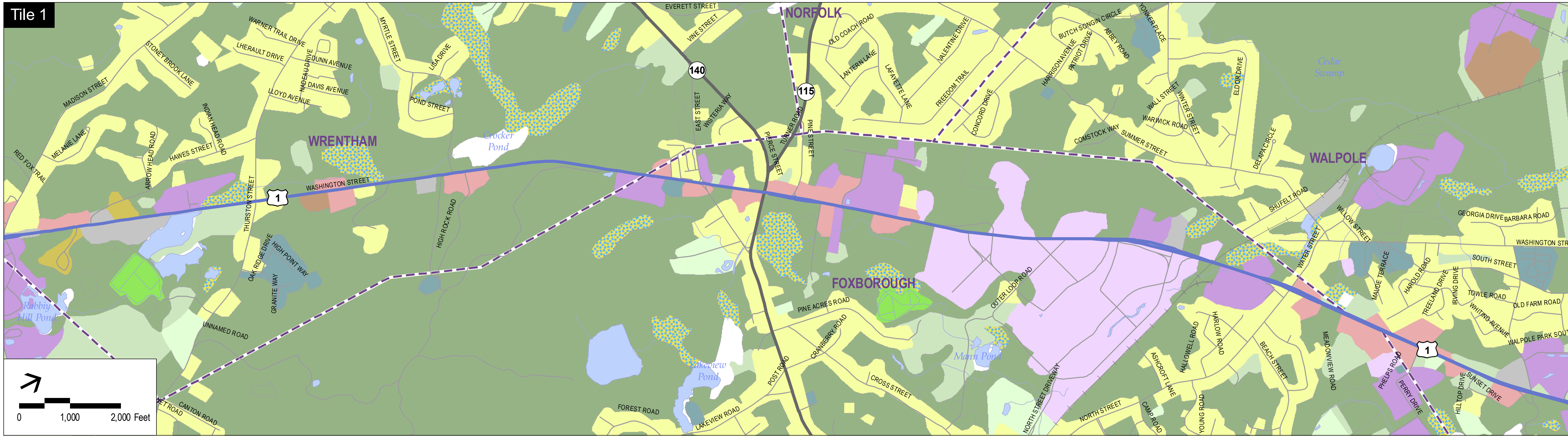
Vanasse Hangen Brustlin, Inc.

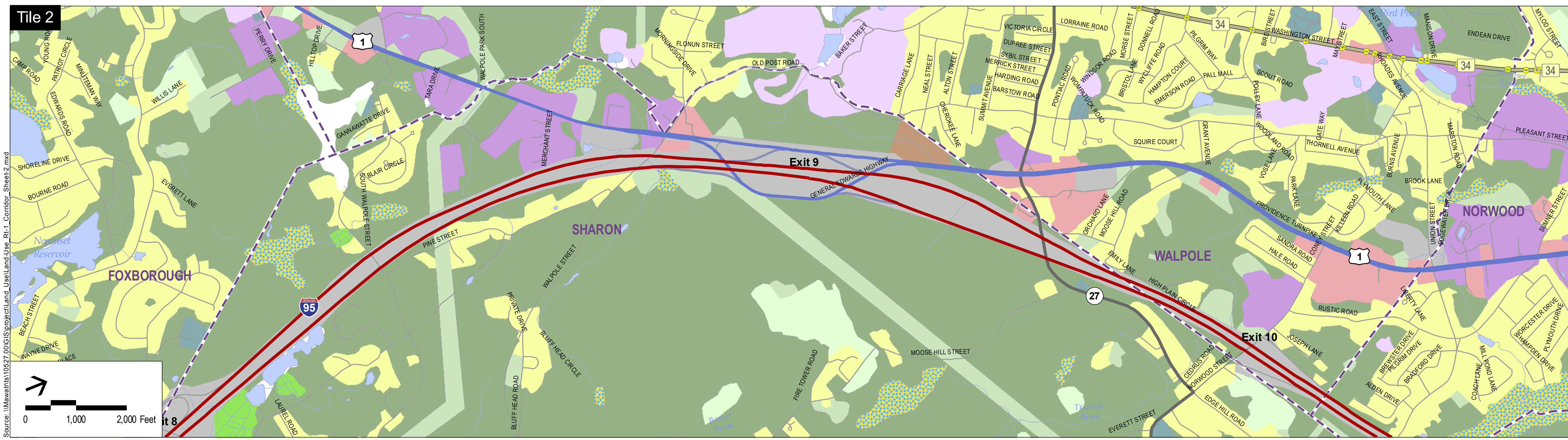
Figure 2-5

Rt-1 Corridor
Land Use

I-95 Corridor Study

Source: Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs



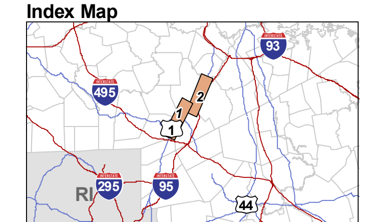


Source: \\Mawant\s\10527.00\GIS\project\Land Use\Land-Use_Rt-1_Corridor_Sheet2.mxd

Legend

Crop Land and Pasture	Mining	Residential	Urban Open	Woody Perennial
Forest	Open Land	Commercial	Transportation	
Non-Forested Wetland	Generic Recreation	Industrial	Waste Disposal	

Index Map



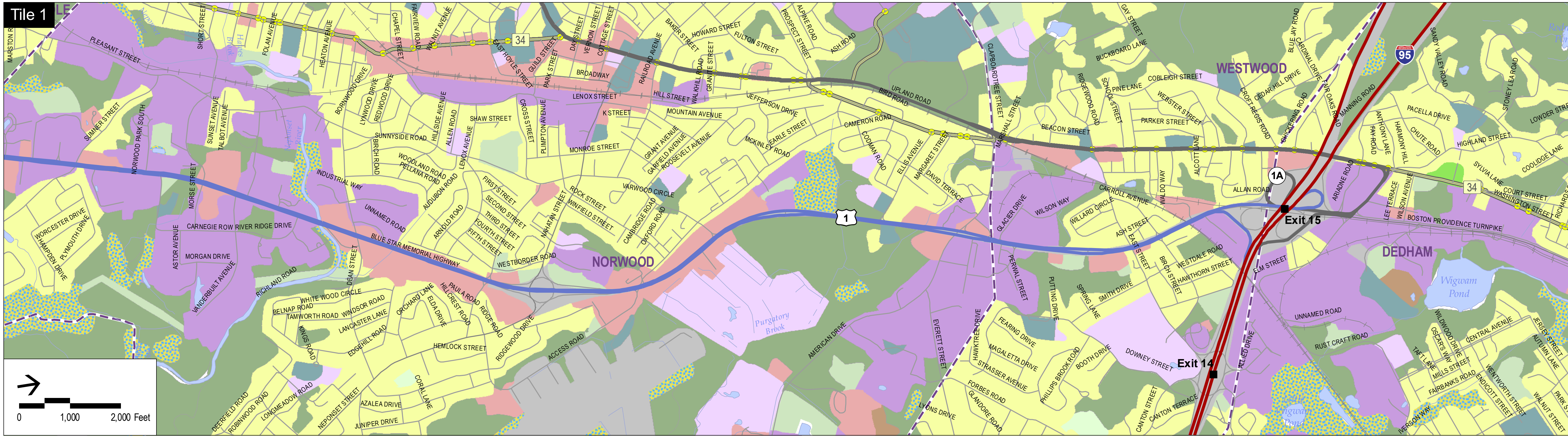
Vanasse Hangen Brustlin, Inc.

Figure 2-6

Rt-1 Corridor
Land Use

I-95 Corridor Study

Source: Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs



Tile 2

Source: \\Mawarlts\10527.00\GIS\project\Land_Use\Land-Use_Rt-1_Corridor_Sheet1-3.mxd

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Legend

Crop Land and Pasture	Mining	Residential	Urban Open	Woody Perennial
Forest	Open Land	Commercial	Transportation	
Non-Forested Wetland	Generic Recreation	Industrial	Waste Disposal	

Source: Office of Geographic and Environmental Information (MassGIS),
Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Index Map

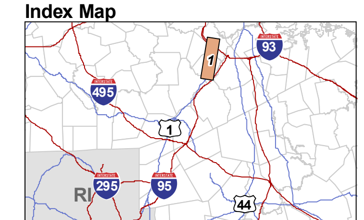

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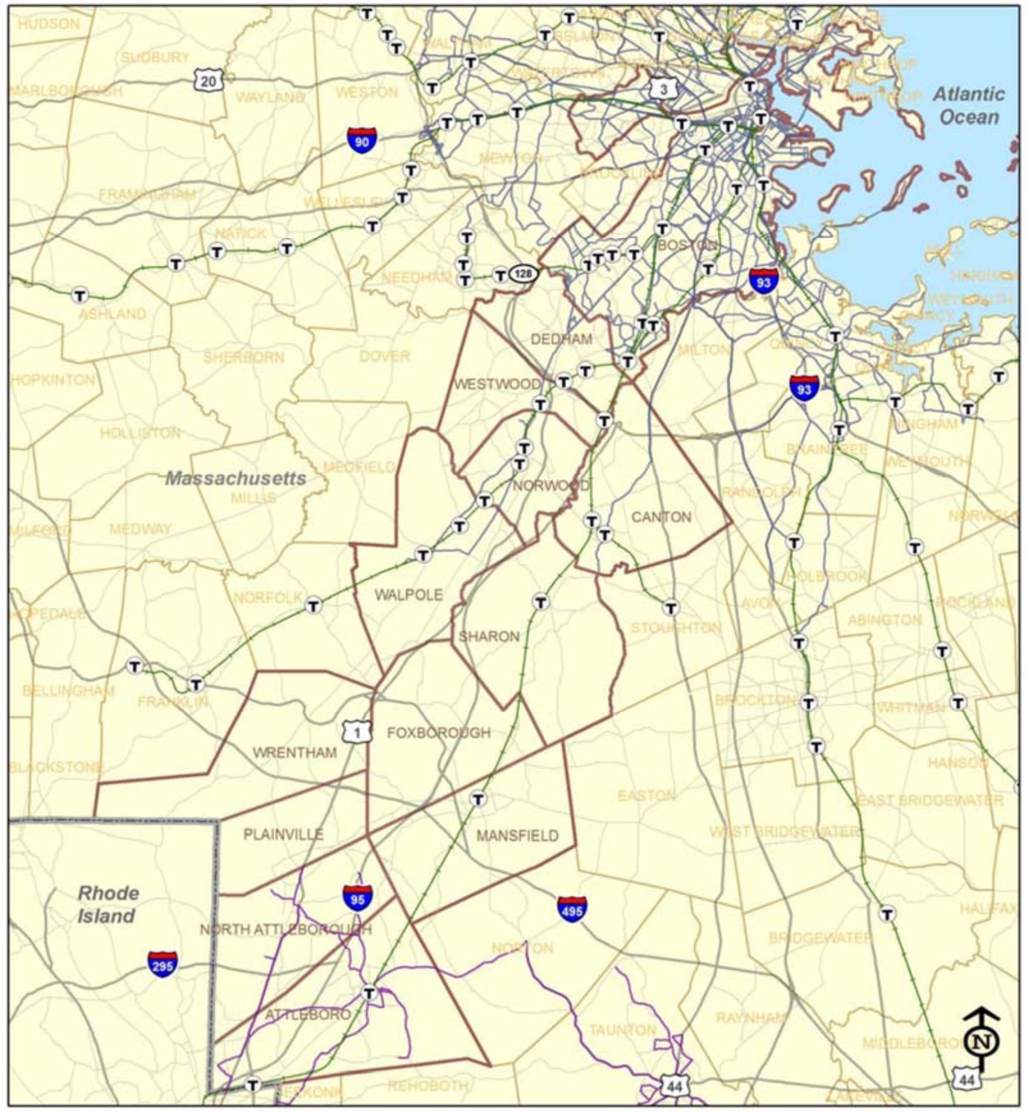
Figure 2-7

Rt-1 Corridor
Land Use

I-95 Corridor Study



Prepared by Fitzgerald & Halliday, Inc. December 2008
Source: U.S. Census 2000 & ESRI
Original in color

massDOT

Legend
MBTA Rail Station
MBTA Commuter Rail
MBTA Bus Route
GATRA Bus Route
State Boundary
Municipality

Miles
0 1.25 2.5 5

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Vanasse Hangen Brustlin, Inc.

Figure 2-8

Existing Transit Service

I-95 South Corridor Study

Ultimately, bicycle and pedestrians connections are important when considering improvement near transit stations and along local roadway systems. Therefore, this study will consider opportunities to develop options which will both create and/or enhance these types of uses on a regional basis.

2.4 Existing Traffic Volumes

This section quantifies the traffic volumes on the I-95 and Route 1 corridors as well as other key roadways serving these corridors. Annual average traffic data, along with typical weekly and daily data are presented to compare traffic trends and characteristics by year, by day-of-week, and by hour of the day. The traffic volumes presented in this section were all gathered by the Massachusetts Department of Transportation. Attached to this report are a series of figures which provide summary graphics indicating both existing peak hour traffic volumes during the morning and evening peak commuting hours, traffic operations in the form of traditional Level of Service (LOS) discussions, as well as a comparison of volume-to-capacity (v/c) ratios for specific links within the corridor.

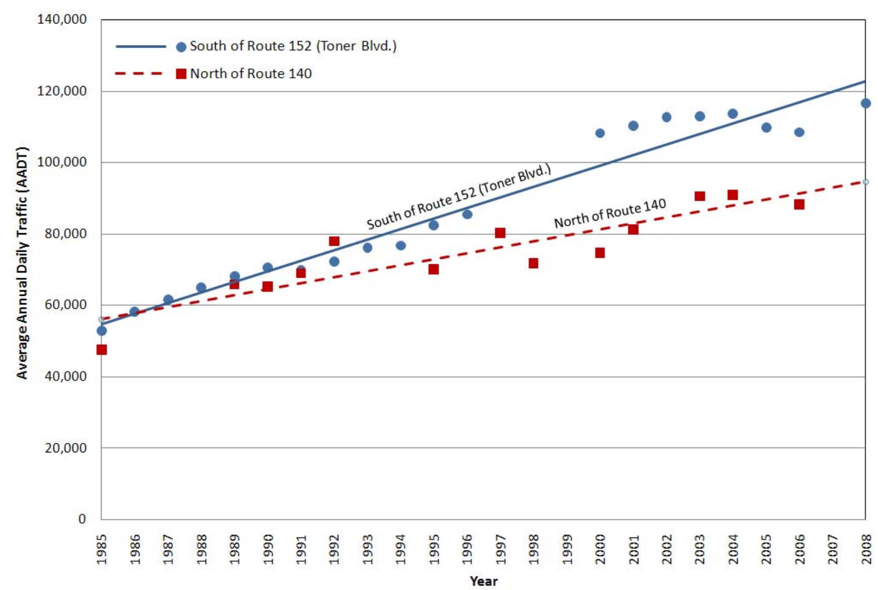
2.4.1 Average Annual Daily Traffic

Traffic data within the study were obtained and reviewed to quantify the magnitude of traffic volumes along the various study area roadways and to identify trends that have occurred over the years. Average annual daily traffic (AADT) for the corridors were provided by MassDOT. AADT is expressed in the terms of vehicles per day, and is adjusted by MassDOT for month-to-month seasonal fluctuations so that the data is representative of an annual average condition and not one particular month. For example, reporting traffic data during the summer would include a significant amount of traffic destined for Cape Cod, Rhode Island, and other summer vacationing locations and could possibly over-estimate traffic volume conditions during these periods on certain roadways. Comparing historical AADTs at one location helps determine trends without the influence of seasonal bias. Comparing AADTs at several locations helps to provide a more accurate comparison of traffic volumes.

Historical Traffic Volumes

Historical traffic volume information provided by MassDOT dating back to 1985 was reviewed for the I-95 and I-495 corridors. These volumes were compared to those collected as part of this study in 2008. Figure 2-9 graphically indicates the rates of growth along the I-95 corridor at a location both north (at Route 140) and south (at Route 152) of I-495. Of note is the fact that there are several "anomalies" over the course of the 23 year observation period; although there is a clear growth pattern over the course of that time.

Figure 2-9
I-95 Historical Average Annual Daily Traffic Volumes (AADT)



Similarly, Figure 2-10 graphically indicates the rates of growth along the I-495 corridor at a location both north and south of the I-95 interchange. While the growth is not as significant as the I-95 corridor, it indicates a steady and consistent growth pattern.

Figure 2-10
I-495 Historical Average Annual Daily Traffic Volumes (AADT)

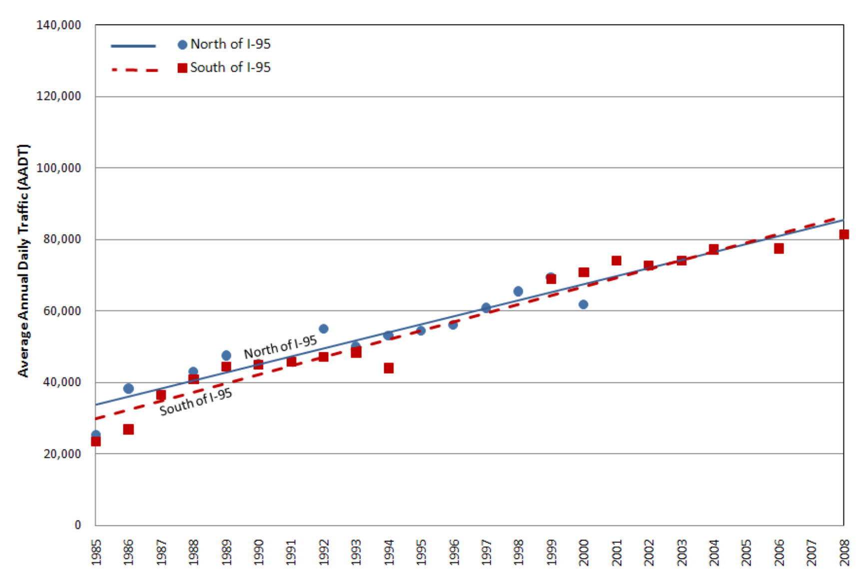


Table 2-6 summarizes the historical growth in traffic volumes in the study area over the approximate twenty three-year period studied. The results of this traffic growth research indicate that the segment of I-95 north of Route 123 has seen an average of approximately 4.1 percent per year over a 23 year period. I-495 just south of I-95 has seen traffic volume growth at an average rate of 5.5 percent per year over a twenty-three year period.

Table 2-6 I-95 and I-495 Historical Average Annual Daily Traffic Volumes (AADT)

Location	Date of Count		Average Annual Traffic Volume		Average Traffic Growth per Year
	First Count	Last Count	First Count	Last Count	
I-95 north of Route 123	1985	2008	35,500	90,828	4.17%
I-95 south of Route 152 (Toner Blvd)	1985	2008	52,745	116,529	3.51%
I-95 north of I-495	1985	2008	47,500	101,300	3.35%
I-95 south of Neponset Street	1985	2008	59,450	110,689	2.74%
I-495 south of I-95	1985	2008	23,571	81,220	5.53%

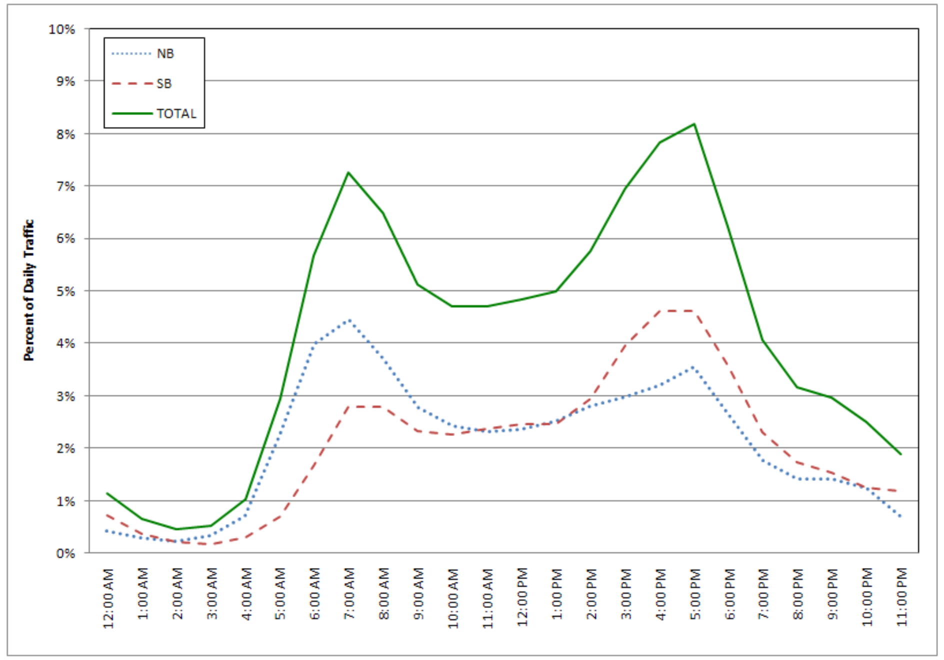
Source: MassDOT count data.

2.4.2 Observed Traffic Volumes

I-95/495 Mainline Traffic Volumes

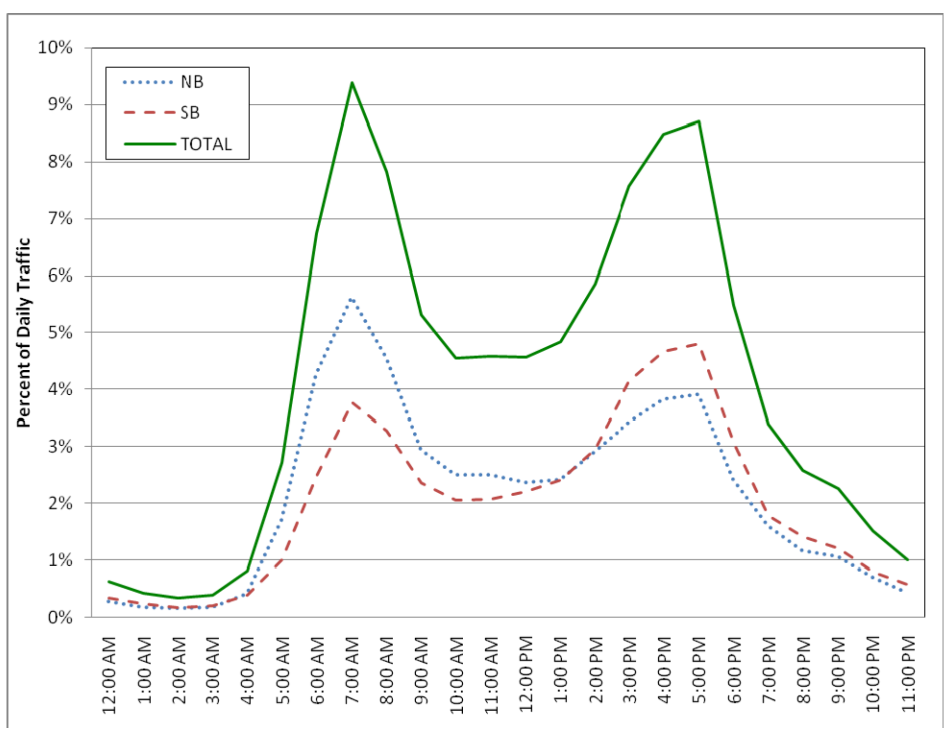
To identify current traffic flow characteristics, daily and hourly traffic volume data were collected by MassDOT in August and September 2008 using permanent count stations along the I-95 and I-495 mainlines. One focus of this study is to evaluate how the I-95 and I-495 mainlines are able to accommodate the fluctuations in daily traffic demands placed upon them. Identifying hourly fluctuations in daily traffic volumes helps to identify the degree of commuting traffic and the periods of peak usage along the corridors. Figure 2-11 and Figure 2-12 present hourly traffic volume profiles for representative segments of I-95 (south of Route 152/Toner Boulevard) and I-495 (south of I-95), respectively. Table 2-7 summarizes the daily and peak hour traffic volumes along the I-95 and I-495 corridors.

Figure 2-11
I-95 Mainline Hourly Traffic Demand Profile



Count Location: I-95 south of Route 152 (Toner Boulevard)

Figure 2-12
I-495 Mainline Hourly Traffic Demand Profile



Count Location: I-495 south of I-95

Table 2-7 I-95 and I-495 Observed Traffic Volume Summary

	Daily [1]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	Weekday	Volume [2]	K Factor [3]	Location	Weekday	Volume [2]	K Factor [3]
I-95 north of Route 123	90,800	6,590	7.3%	62% NB	7,280	8.0%	56% SB
I-95 south of Route 152 (Toner Blvd)	116,500	8,455	7.3%	61% NB	9,530	8.2%	56% SB
I-95 north of I-495	101,300	7,540	7.4%	66% NB	7,900	7.8%	62% SB
I-95 south of Neponset Street	110,700	7,790	7.0%	65% NB	8,220	7.4%	67% SB
I-495 south of I-95	81,200	7,625	9.4%	60% NB	7,080	8.7%	55% SB

Source: MassDOT and Vanasse Hangen Brustlin, Inc.; based on permanent count station data collected in August and September 2008.
1 average daily traffic volume expressed in vehicles per day
2 expressed in vehicles per hour
3 percent of daily traffic that occurs during the peak hour
4 directional distribution of peak hour traffic

As Figure 2-11 and Table 2-7 indicate, the morning and evening peak hour traffic volumes represent between seven and nine percent of the daily traffic along I-95. In general, traffic volumes are more concentrated during the evening peak hour when compared to the morning peak hour. The peak directional flow of traffic is northbound during the morning peak hour and southbound during the evening peak hour along all segments of I-95. Traffic volumes along I-95 south of Route 152/Toner Boulevard (Exit 5) are the highest in the study area; this segment of I-95 carries 116,500 vehicles per day with approximately seven and eight percent of this volume occurring during the morning and evening peak hours, respectively.

Traffic volume data was collected for the segment of I-495 south of I-95. As Figure 2-12 and Table 2-7 indicate, I-495 carries approximately 81,200 vehicles per day with approximately nine percent of this volume occurring during the morning and evening peak hours.

It is clear from a side-by-side comparison of I-95 and I-495's daily demand profile shown in Figure 2-11 and 2-12 that I-495 has more pronounced peaks of traffic in both the morning and evening commuter hours – this appears to indicate that during these periods, I-495 is used as a commuter corridor. Moreover, during off-peak periods, the I-95 corridor is more actively utilized.

I-95/495 Local Interchange Traffic Volumes

Weekday daily volumes along the local roadways near each interchange with I-95 and I-495 were collected using automated traffic recorders (ATRs). Table 2-8 summarizes the daily and peak hour traffic volumes along the local study area roadways.

As Table 2-8 indicates, traffic volumes along Route 1 near Interchange 9 of I-95 are the highest in the study area. At this location Route 1 carries approximately 38,200 vehicles per day with approximately six and seven percent of this volume occurring during the morning and evening peak hours, respectively.

Table 2-8 Local Roadway Observed Traffic Volume Summary

	Daily [1]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	Weekday	Volume [2]	K Factor [3]	Location	Weekday	Volume [2]	K Factor [3]
Route 1 under I-95 (Exit 1)	20,300	1,020	5.0%	66% SB	1,710	8.4%	58% SB
Route 1A under I-95 (Exit 2)	35,000	1,810	5.2%	52% SB	3,045	8.7%	50% NB
Route 123 under I-95 (Exit 3)	24,400	1,490	6.1%	58% EB	2,075	8.5%	53% WB
Toner Blvd. over I-95 (Exit 5)	23,500	1,645	7.0%	52% EB	1,945	8.3%	53% WB
Route 152 south of Toner Blvd.	23,300	1,535	6.6%	60% NB	1,900	8.2%	56% SB
Route 140 under I-95 (Exit 7)	27,800	1,870	6.7%	54% NB	2,705	9.7%	52% SB
South Main St. over I-95 (Exit 8)	15,900	1,305	8.2%	54% EB	1,315	8.3%	58% WB
Ramp from Rt. 1S to Rt. 1N (I-95 Exit 9)	800	50	6.3%	n/a	60	7.5%	n/a
Route 1 north of I-95 Exit 9 (Exit 9)	38,200	2,095	5.5%	86% NB	2,525	6.6%	73% SB
Coney St. over I-95 (Exit 10)	12,400	810	6.5%	53% EB	1,095	8.8%	79% WB
Neponset St. over I-95 (Exit 11)	28,000	1,875	6.7%	62% WB	2,180	7.8%	52% EB
Dedham St. over I-95 (Slip Ramp)	13,100	1,465	11.2%	71% WB	1,175	9.0%	62% EB
South Main St. over I-495 (Exit 11/12)	16,300	1,070	6.6%	89% NB	1,095	6.7%	70% NB
Route 1 over I-495 (Exit 14)	29,900	2,025	6.8%	71% NB	2,635	8.8%	67% SB
Route 1A under I-495 (Exit 15)	19,200	1,000	5.2%	54% NB	1,480	7.7%	53% SB

Source: MassDOT and Vanasse Hangen Brustlin, Inc.; based on automatic traffic recorder counts conducted in July, August, and September 2008.
1 average daily traffic volume expressed in vehicles per day
2 expressed in vehicles per hour
3 percent of daily traffic that occurs during the peak hour
4 directional distribution of peak hour traffic

Route 1 Traffic Volumes

Finally, weekday daily volumes along Route 1 were also collected using automated traffic recorders (ATRs). Table 2-9 summarizes the daily and peak hour traffic volumes along Route 1.

As Table 2-9 indicates, traffic volumes along Route 1 are the highest in the northern part of the study area. Route 1 south of University Avenue carries the greatest traffic volumes along the corridor with approximately 44,300 vehicles per day with approximately six percent of this volume occurring during the morning and evening peak hours.

Table 2-9 Route 1 Observed Traffic Volume Summary

	Daily [1]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Location	Weekday	Volume [2]	K Factor [3]	Dir. Dist. [4]	Volume	K Factor	Dir. Dist.
Route 1 south of University Ave.	44,300	2,560	5.8%	57% NB	2,555	5.8%	54% NB
Route 1 south of Dean St.	38,600	2,480	6.4%	56% NB	2,595	6.7%	51% NB
Route 1 south of Coney St.	33,700	2,230	6.6%	66% NB	2,145	6.4%	57% SB
Route 1 south of Old Post Rd.	32,100	2,085	6.5%	57% NB	2,000	6.2%	56% SB
Route 1 south of Pine St. (Walpole)	29,400	2,040	6.9%	68% NB	2,340	8.0%	65% SB
Route 1 south of Pine St. (Foxborough)	30,300	2,260	7.5%	66% NB	1,865	6.1%	57% SB
Route 1 south of Thurston St.	26,400	2,015	7.6%	74% NB	2,150	8.1%	67% SB
Route 1 south of Route 106	17,500	1,200	6.9%	78% NB	1,560	8.9%	69% SB
Route 1 south of Route 1A (North Attleboro	19,800	1,315	6.6%	67% NB	1,735	8.7%	62% SB
Route 1 south of Allen Ave.	26,900	1,145	4.3%	53% NB	1,995	7.4%	54% SB
Route 1 south of Route 1A (Attleboro)	14,300	645	4.5%	55% NB	1,070	7.5%	56% SB
Route 1 south of Bacon St.	25,000	1,240	5.0%	51% SB	2,015	8.1%	50% SB

Source: MassDOT and Vanasse Hangen Brustlin, Inc.; based on automatic traffic recorder counts conducted in July 2008.
1 average daily traffic volume expressed in vehicles per day
2 expressed in vehicles per hour
3 percent of daily traffic that occurs during the peak hour
4 directional distribution of peak hour traffic

Peak Hour Volumes

Weekday daily and hourly traffic volumes along each ramp at I-95 and I-495 study area interchanges were collected using automated traffic recorders (ATRs). This data, coupled with hourly mainline permanent count station data, was used to establish the 2008 baseline weekday morning and evening peak hour traffic volume networks for the I-95 and I-495 corridors. The morning and evening peak hours along both the I-95 and I-495 corridors generally occurred from 7:00 AM – 8:00 AM and from 5:00 PM – 6:00 PM, respectively. These volumes were then used in the peak hour traffic analysis of the basic freeway segments; merge/diverge ramps, and weaving segments. The existing conditions weekday morning and weekday evening peak hour traffic volumes as well as the corresponding operational levels of service for the I-95 and I-495 corridors are shown graphically on Figures 2-13 through 2-19.

Weekday morning and evening peak hour (7:00 AM – 9:00 AM; 4:00 PM - 6:00 PM) volumes were collected at all intersections of I-95/I-495 ramp termini with local streets and at several predefined intersections that are adjacent to the I-95 and I-495 mainlines and are potentially impacted by traffic entering onto or exiting from I-95 and I-495. These data were collected using manual turning movement/classification counts (TMCs) to identify current traffic volumes traveling through the key intersections in the region. These 2008 data were used to establish the baseline traffic conditions for the peak hour traffic analysis of study area intersections. A morning and evening peak hour was established for each interchange within the study area. The existing conditions weekday morning and weekday evening peak hour intersection traffic volumes are shown graphically for each of the interchanges along I-95 in the attached Figures 2-20 through 2-28. Similarly, existing conditions for each of the study area interchanges along I-495 are shown on the following attached Figures 2-29 through 2-31.

Weekday morning and evening peak hour (7:00 AM – 9:00 AM; 4:00 PM - 6:00 PM) volumes were also collected at all Route 1 study area intersections using manual turning movement/classification counts (TMCs). These 2008 data were used to establish the baseline traffic conditions for the peak hour traffic analysis of study area intersections. Due to the spacing and number of curb cuts between Route 1 study area intersections, morning and evening peak hours were not established for the entire corridor. Rather, individual morning and evening peak hour traffic volumes were used for each Route 1 intersection. These existing condition traffic volumes are shown graphically for Route 1 on their own set of Figures 2-32 through 2-51, which are also attached. In addition to the Route 1 study area intersections, data was collected at three additional locations to supplement future alternatives development. These locations include Route 1A at Route 123, Route 1A at Elmwood Street, and Route 1A at Whiting Street. Traffic volumes are presented in the Route 1 figures but traffic analysis was not completed for these locations. To further support the alternatives development process, an Origin-Destination Study was conducted by the Central Transportation Planning Staff for the Route 1, Route 140, and Route 115 area in Foxborough. The results of this study are included in the Appendix and summarized in Chapter 4 – Alternatives Development and Analysis.

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Legend

Segments and Ramps Level of Service (LOS)

A/B

C/D

E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

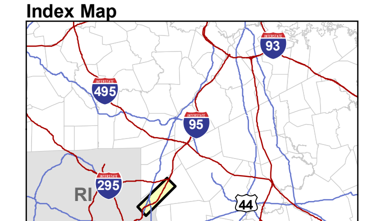

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Figure 2-13

Existing AM and PM Volumes
and Level of Service
I-95 Corridor - Sheet 1 of 5

I-95 South Corridor Study

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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

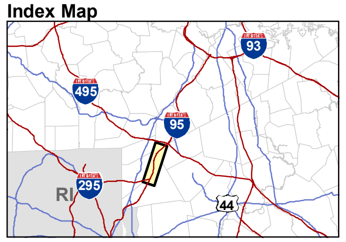

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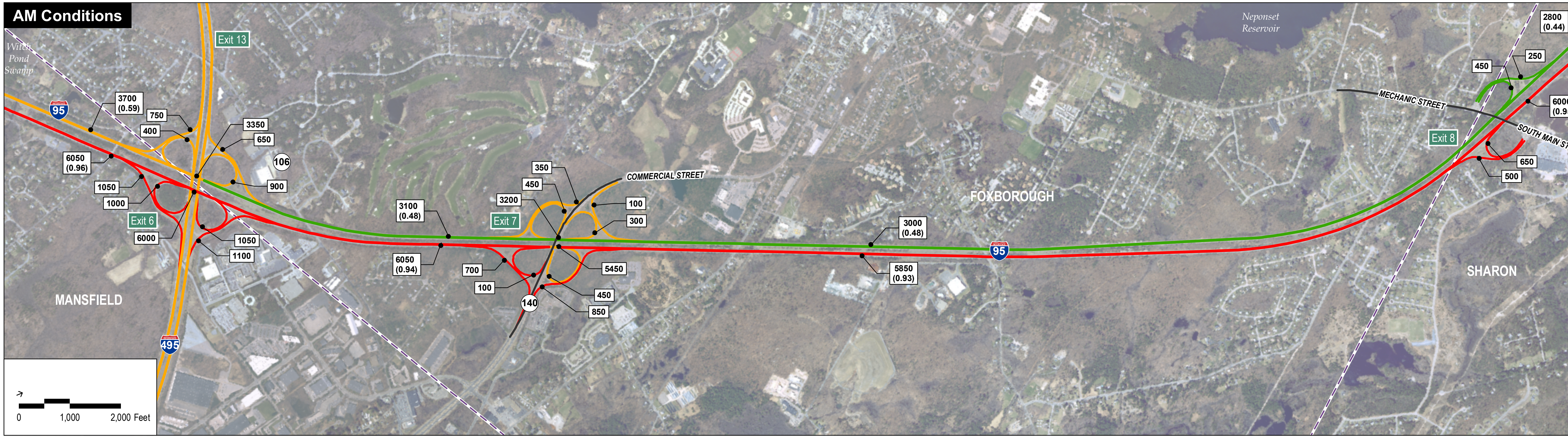
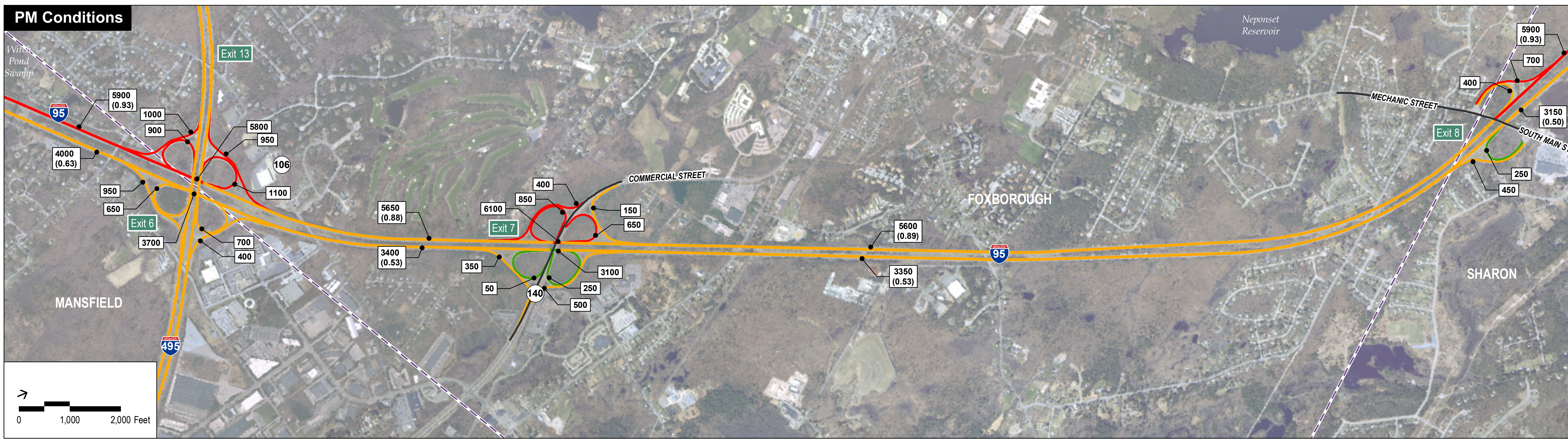
Figure 2-14

Existing AM and PM Volumes
and Level of Service
I-95 Corridor - Sheet 2 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

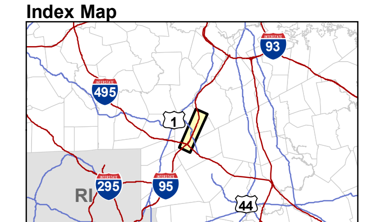

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Figure 2-15

Existing AM and PM Volumes
and Level of Service
I-95 Corridor - Sheet 3 of 5

I-95 South Corridor Study

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Massachusetts Department of Transportation

Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

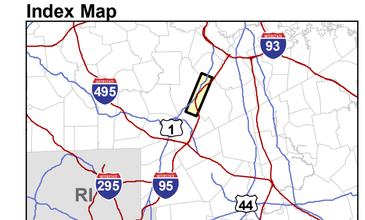

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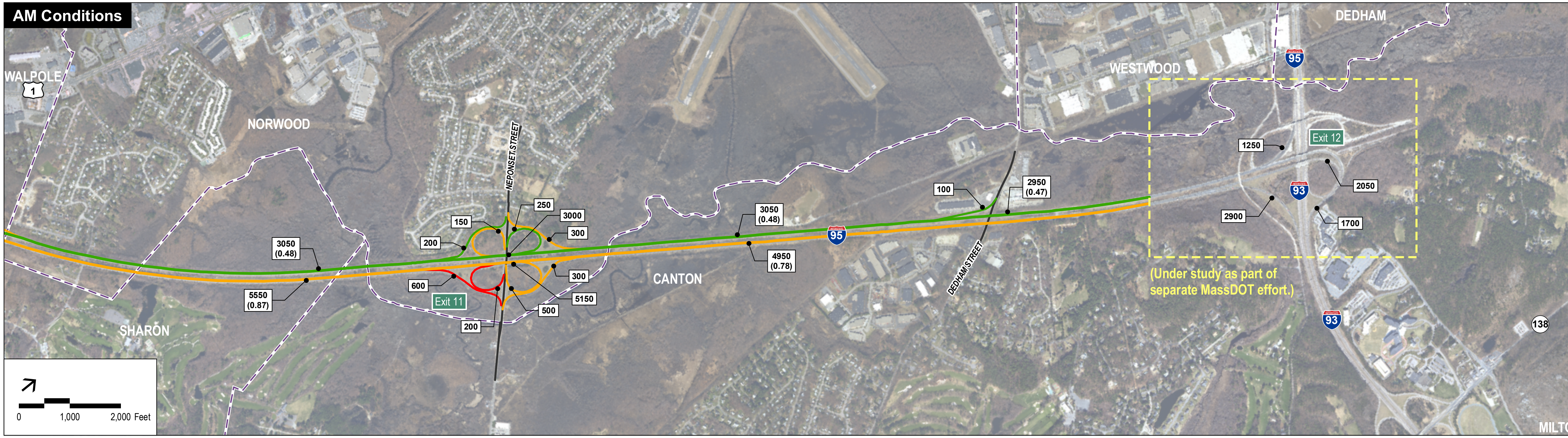
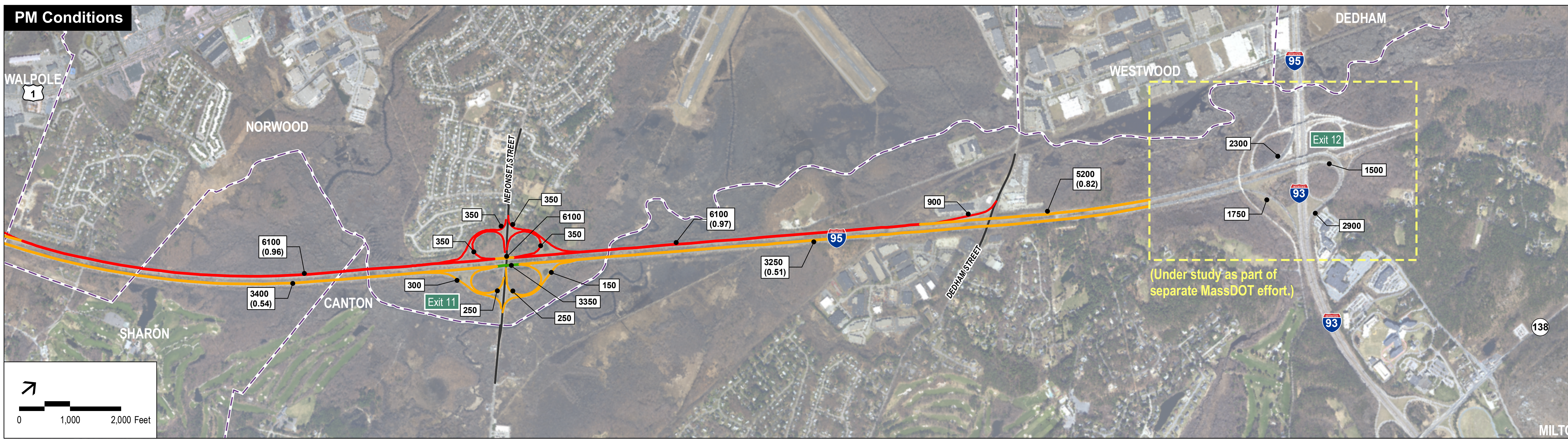
Figure 2-16

Existing AM and PM Volumes
and Level of Service
I-95 Corridor - Sheet 4 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

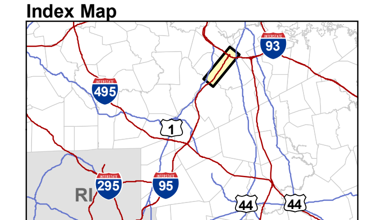

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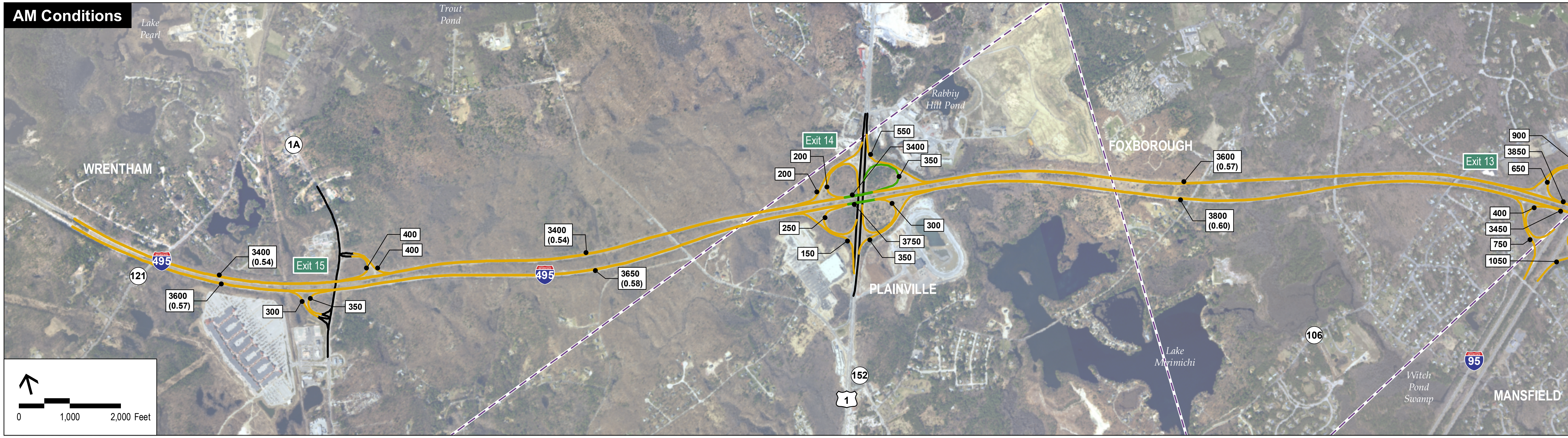
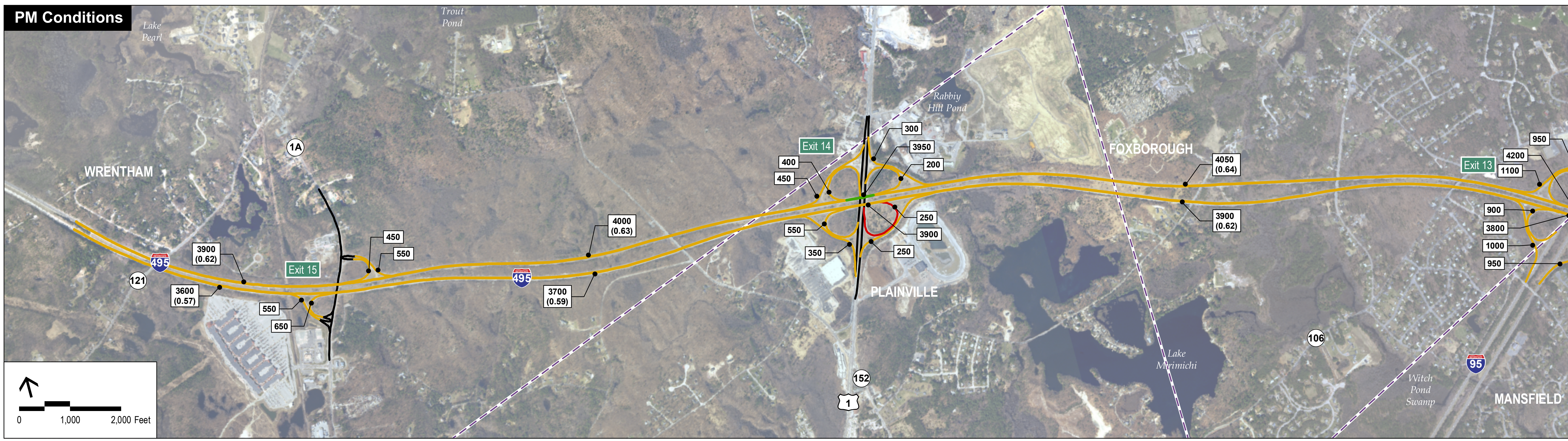
Figure 2-17

Existing AM and PM Volumes
and Level of Service
I-95 Corridor - Sheet 5 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89)	Volume (Volume/Capacity Ratio)

Index Map

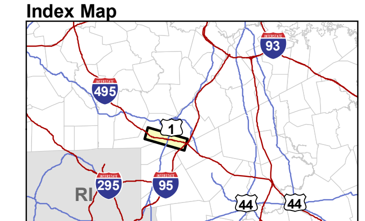

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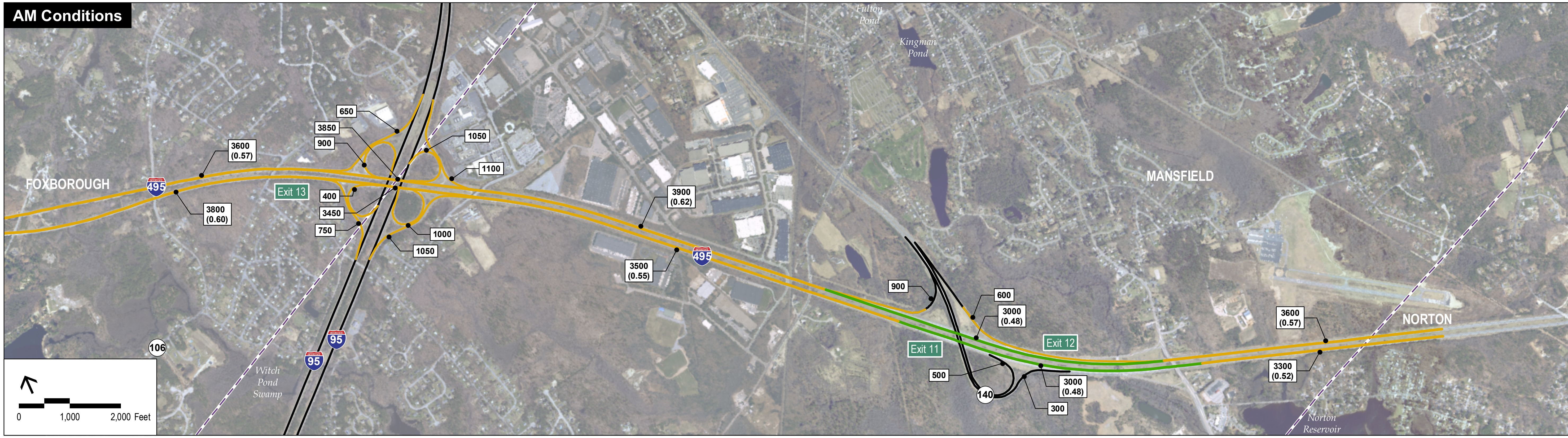
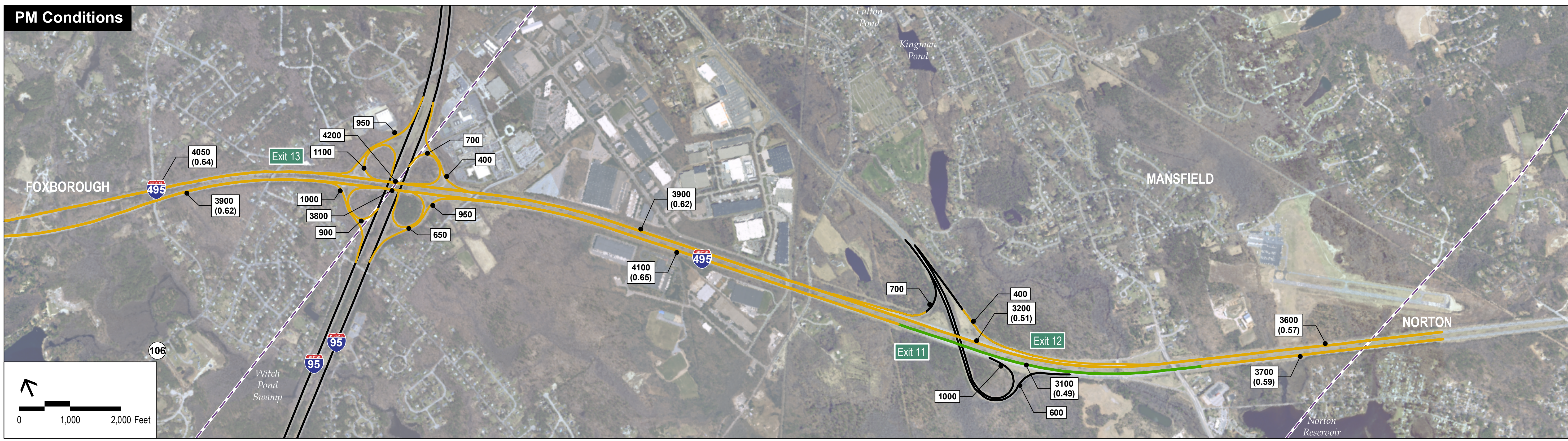
Figure 2-18

Existing AM and PM Volumes and Level of Service I-495 Corridor - Sheet 1 of 2

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

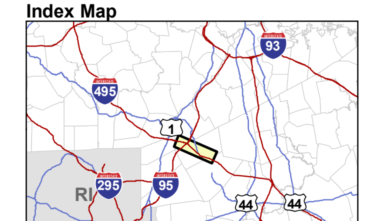

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Figure 2-19

Existing AM and PM Volumes and Level of Service I-495 Corridor - Sheet 2 of 2

I-95 South Corridor Study

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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

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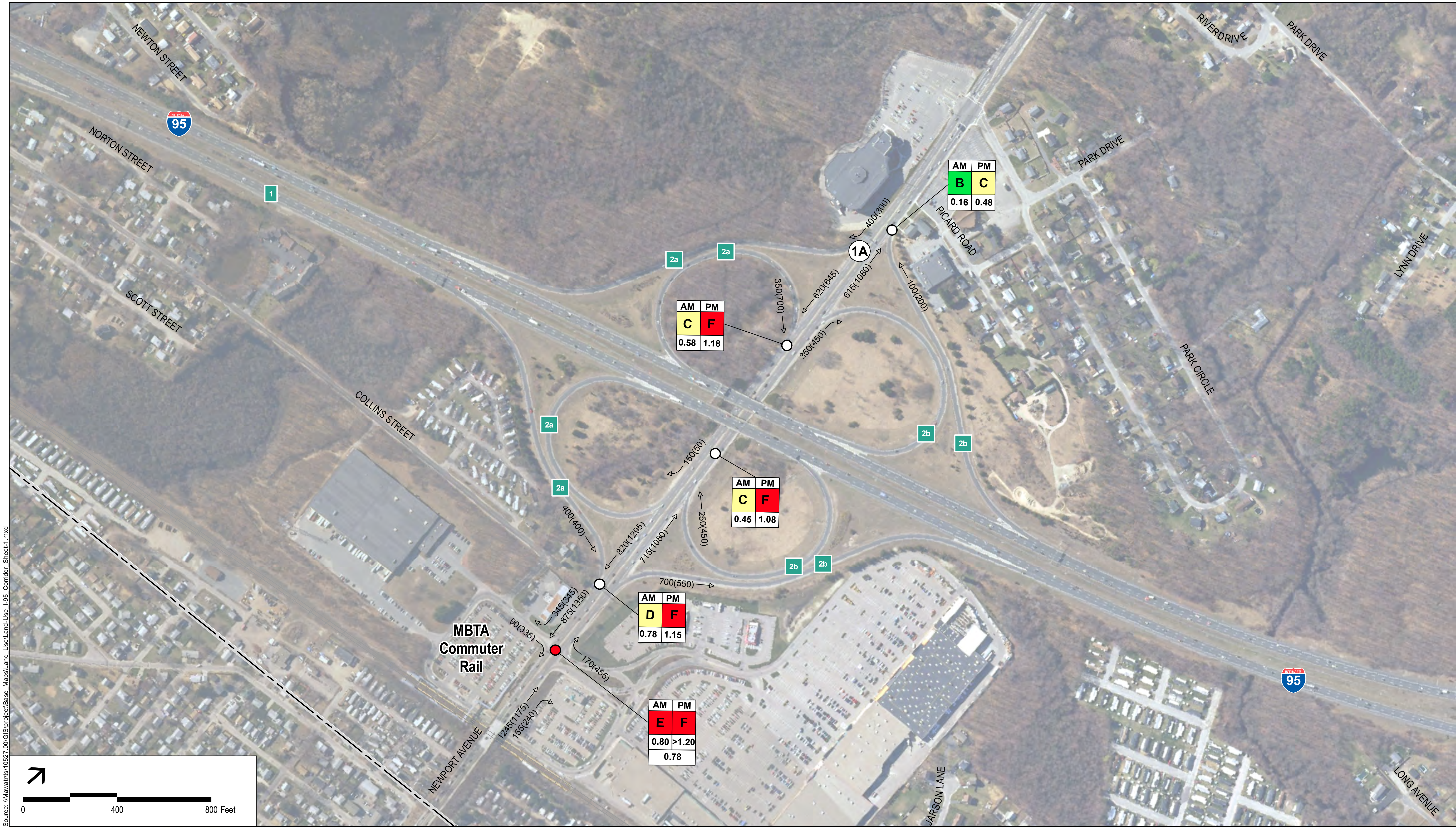
Figure 2-20

I-95 Interchange 1

Route 1 - Attleboro



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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
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Index Map

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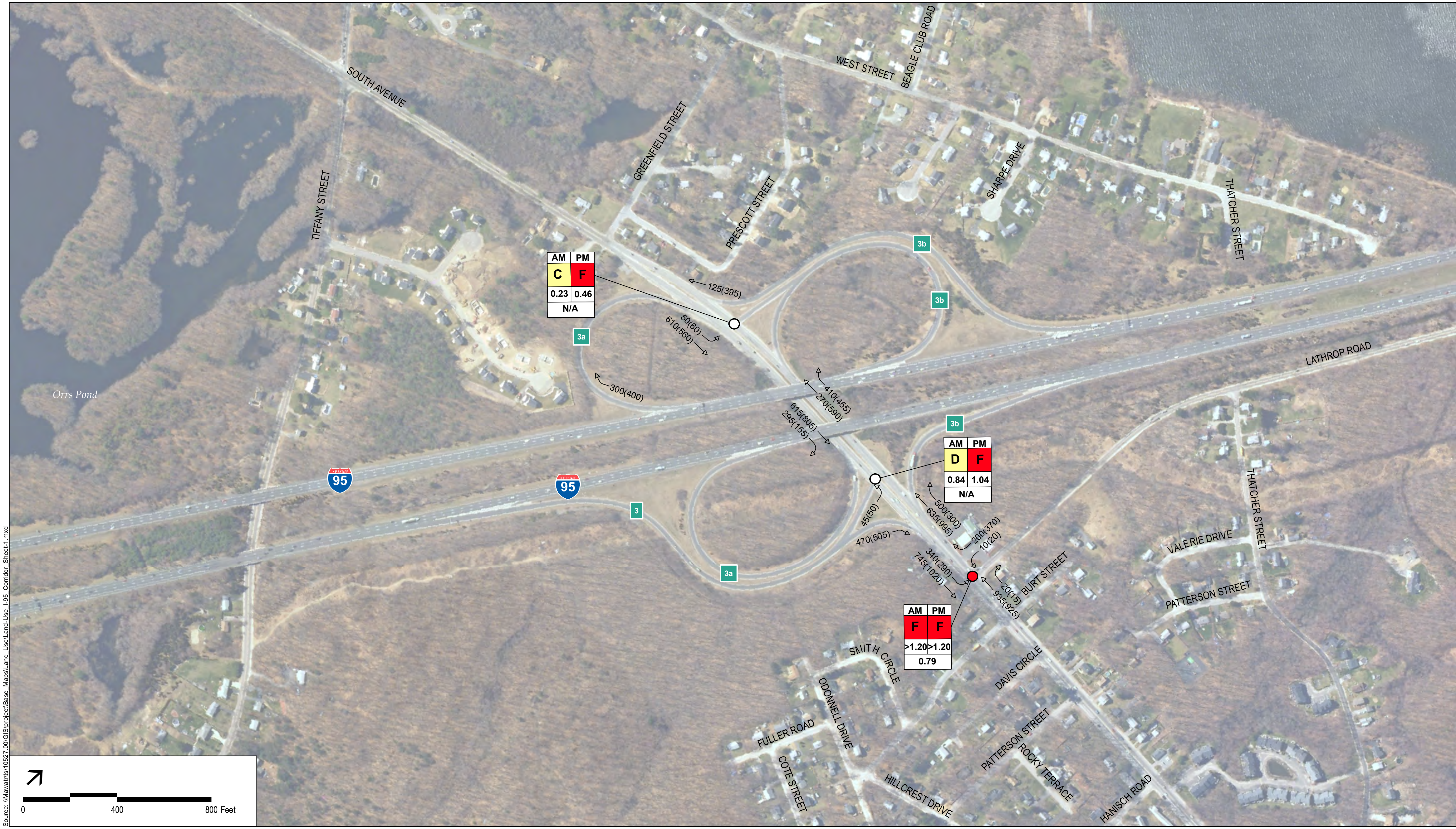
Figure 2-21

I-95 Interchange 2

Route 1A - Attleboro



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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

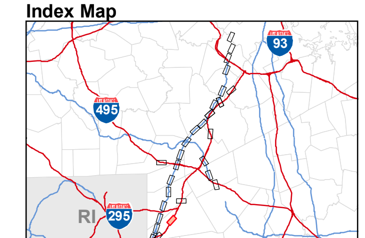

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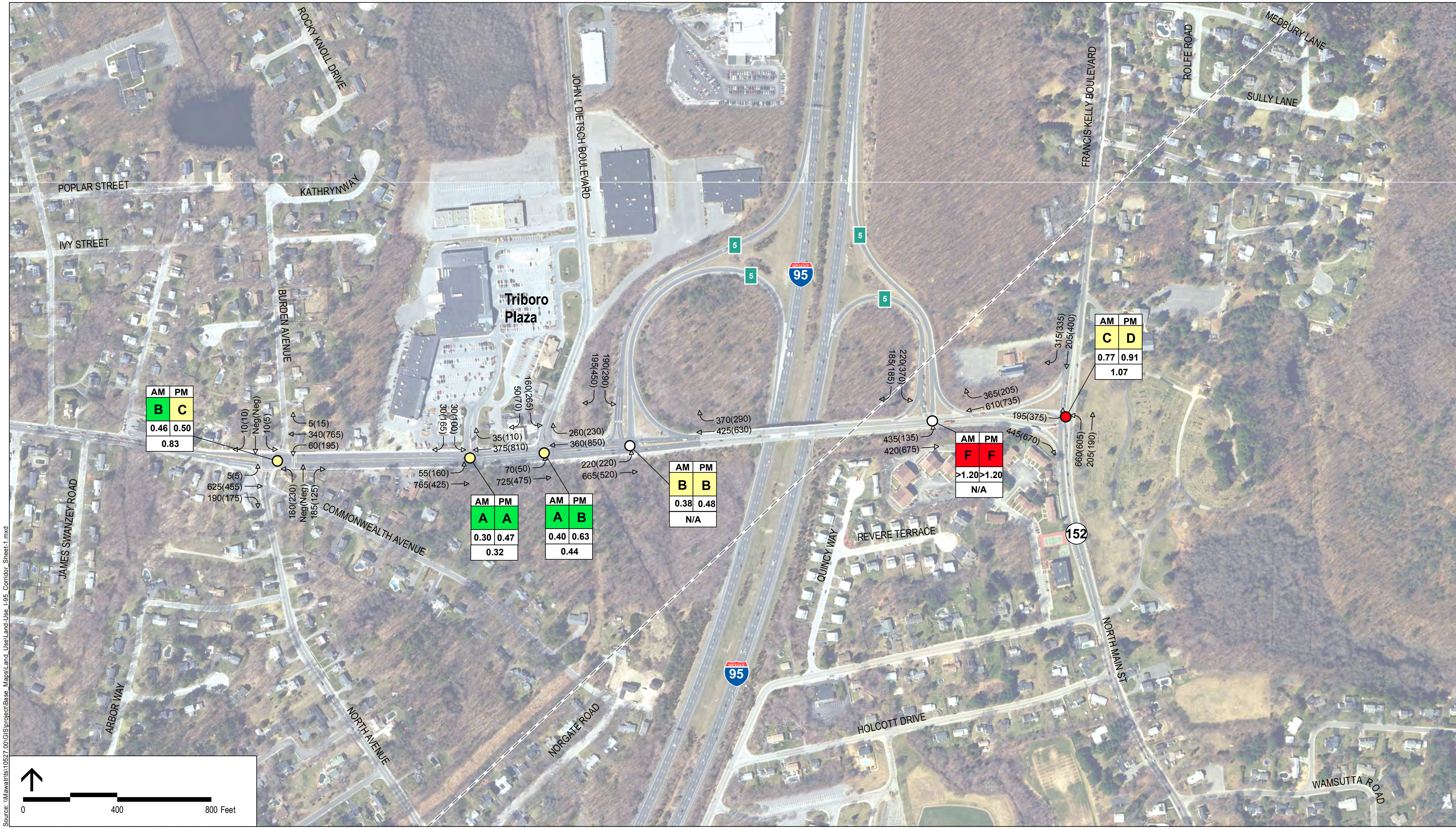
Figure 2-22

I-95 Interchange 3

Route 123 - Attleboro



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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
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Index Map

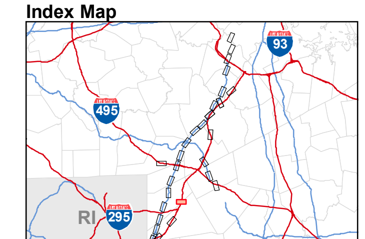

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Figure 2-23

I-95 Interchange 5

Toner Boulevard - North Attleborough

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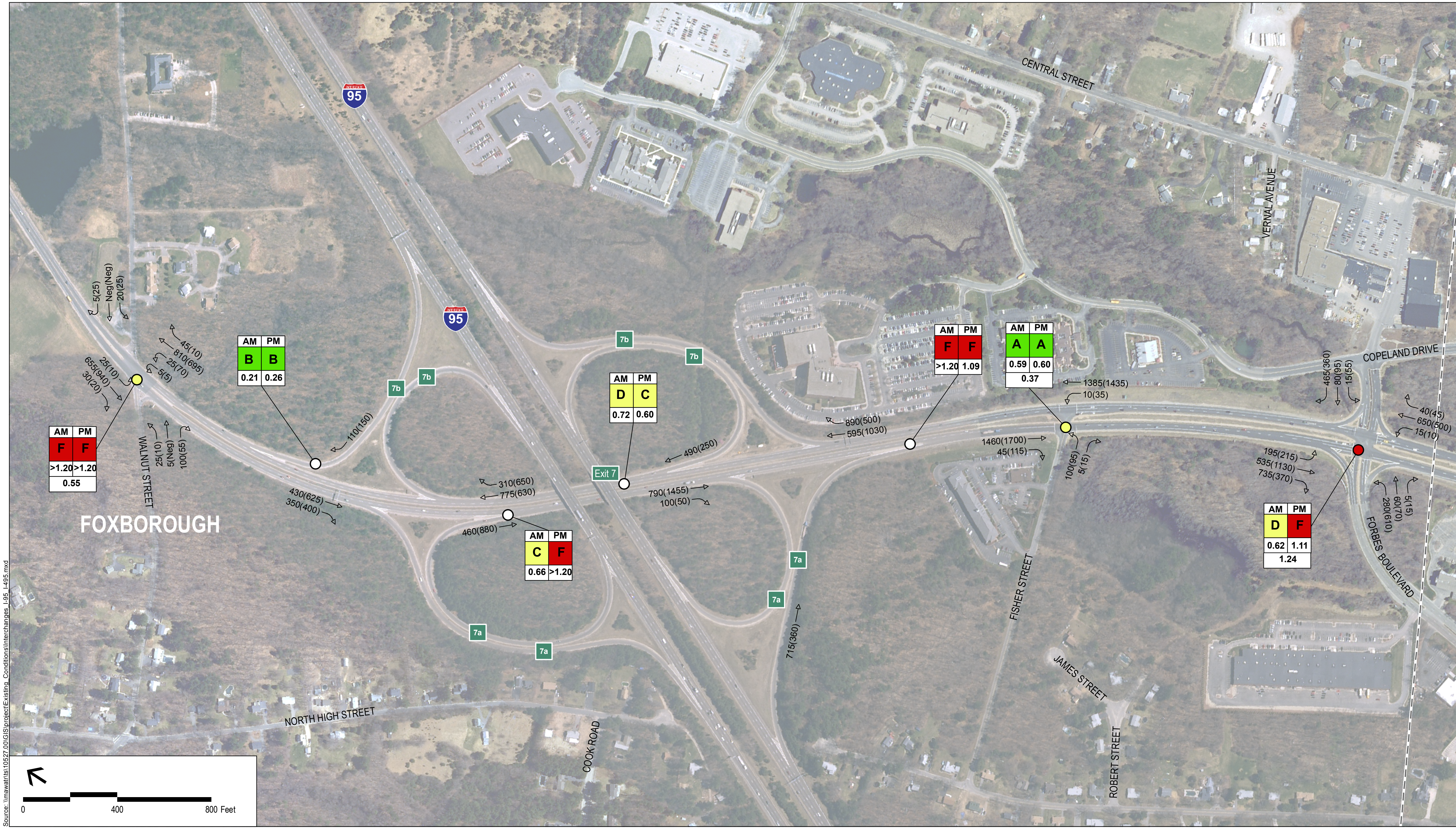

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

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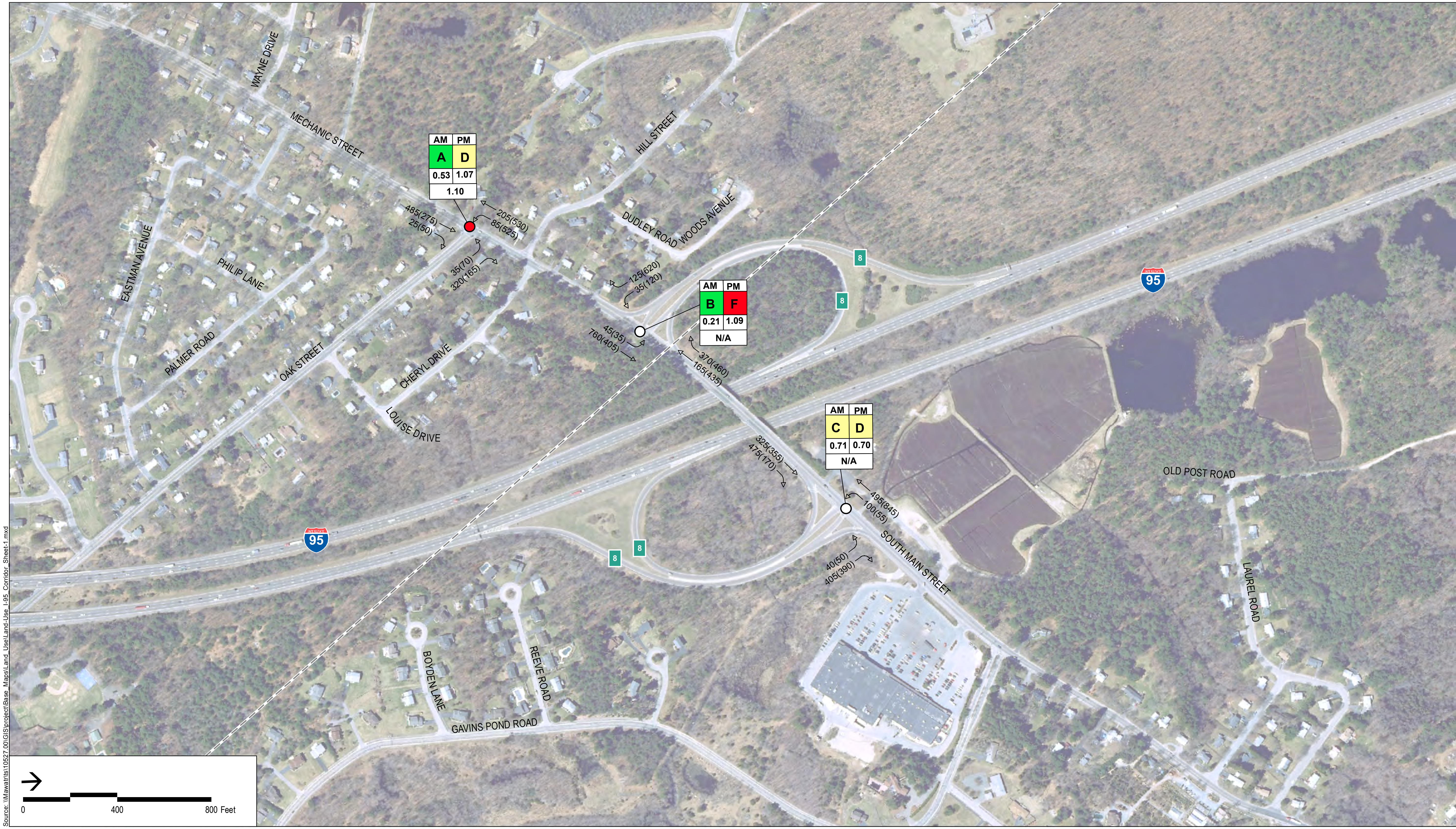
Figure 2-24

I-95 Interchange 7

Route 140 - Mansfield



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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes

No

N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

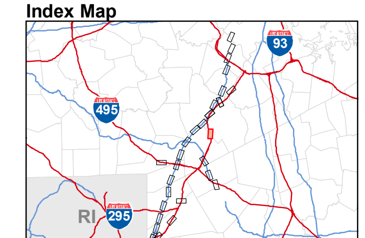

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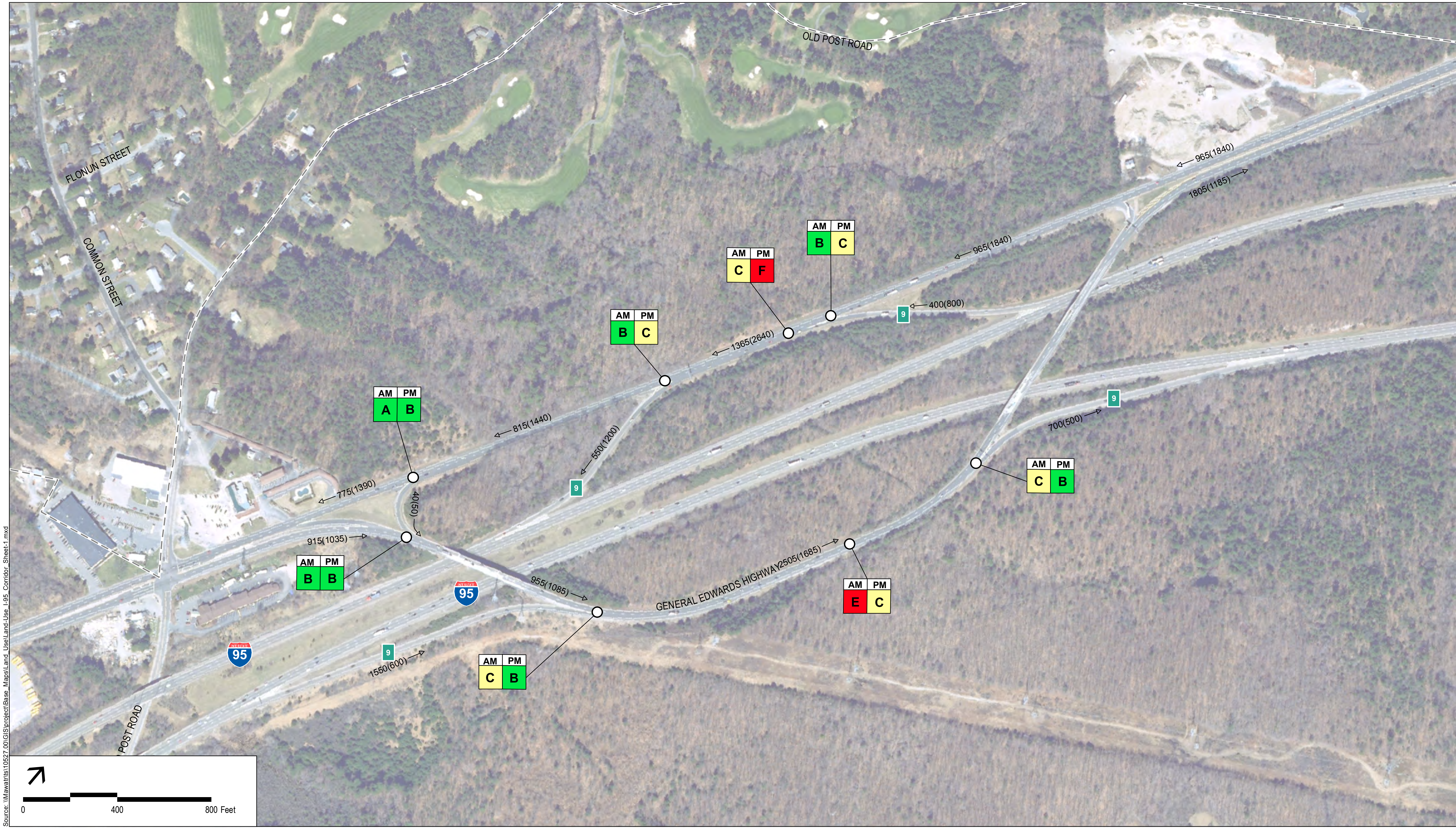
Figure 2-25

I-95 Interchange 8

Mechanic St. / South Main St. - Sharon



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Legend

Intersection Level of Service

AM PM
A F — Level of Service
x.xx x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

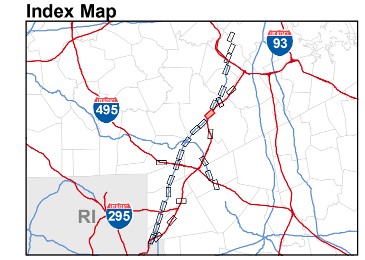

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Figure 2-26

I-95 Interchange 9

Route 1 - Sharon

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

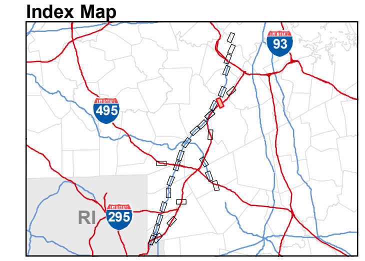

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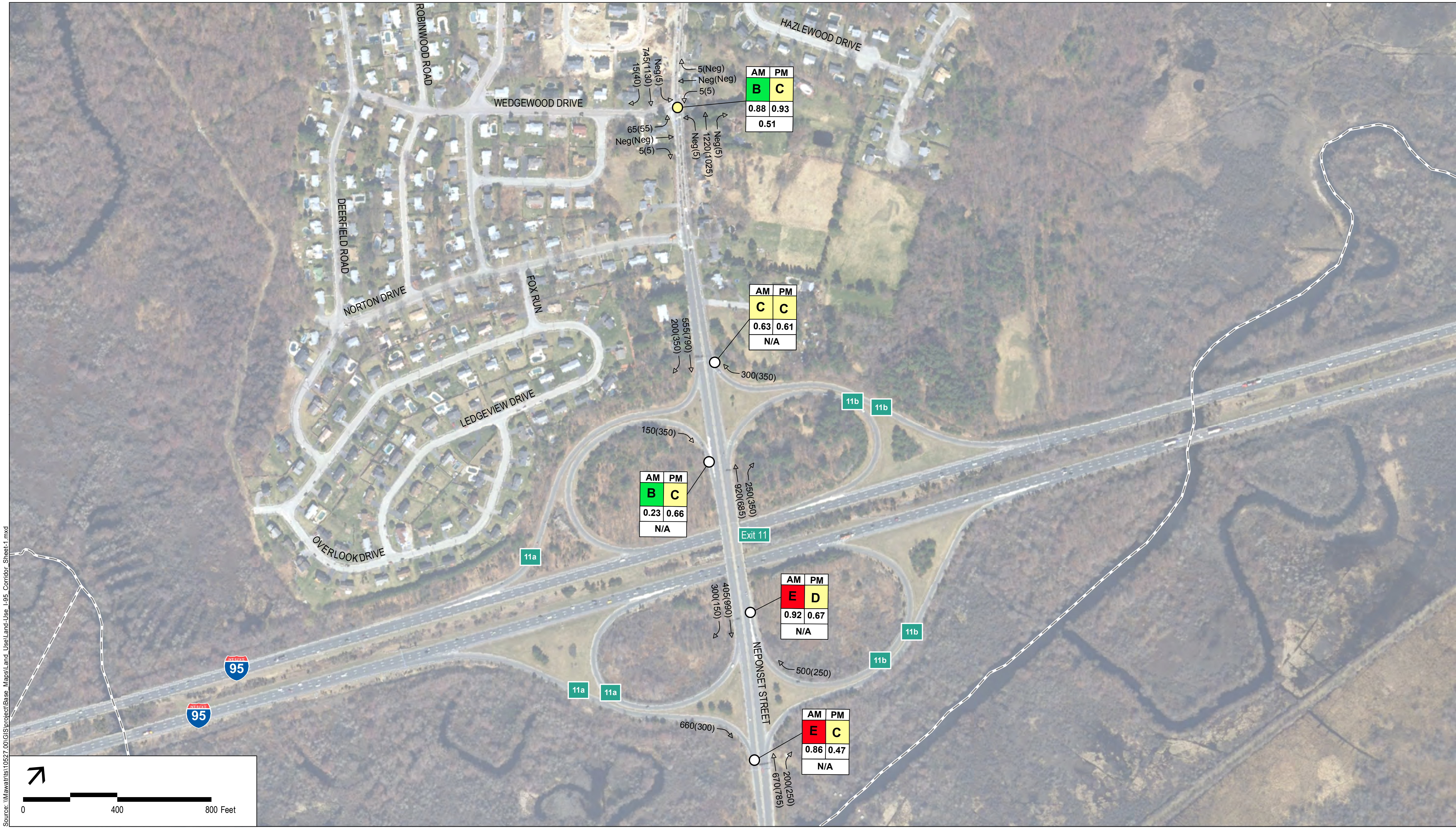
Figure 2-27

I-95 Interchange 10

Coney Street - Walpole



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

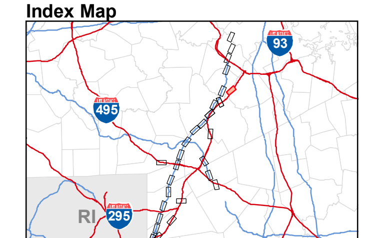


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Figure 2-28

I-95 Interchange 11

Neponset Street - Norwood

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

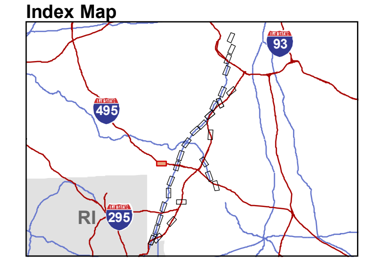

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Figure 2-29

I-495 Interchange 15

Route 1A - Wrentham

Source: \\Mawarts\10527.00\GIS\project\Base_Maps\Land_Use\Land-Use_I-95_Corridor_Sheet-1.mxd

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Legend

Intersection Level of Service

AM PM — A/B — C/D — E/F
A F — Level of Service
x.xx x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

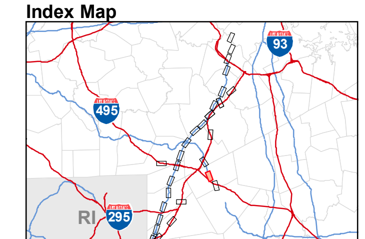

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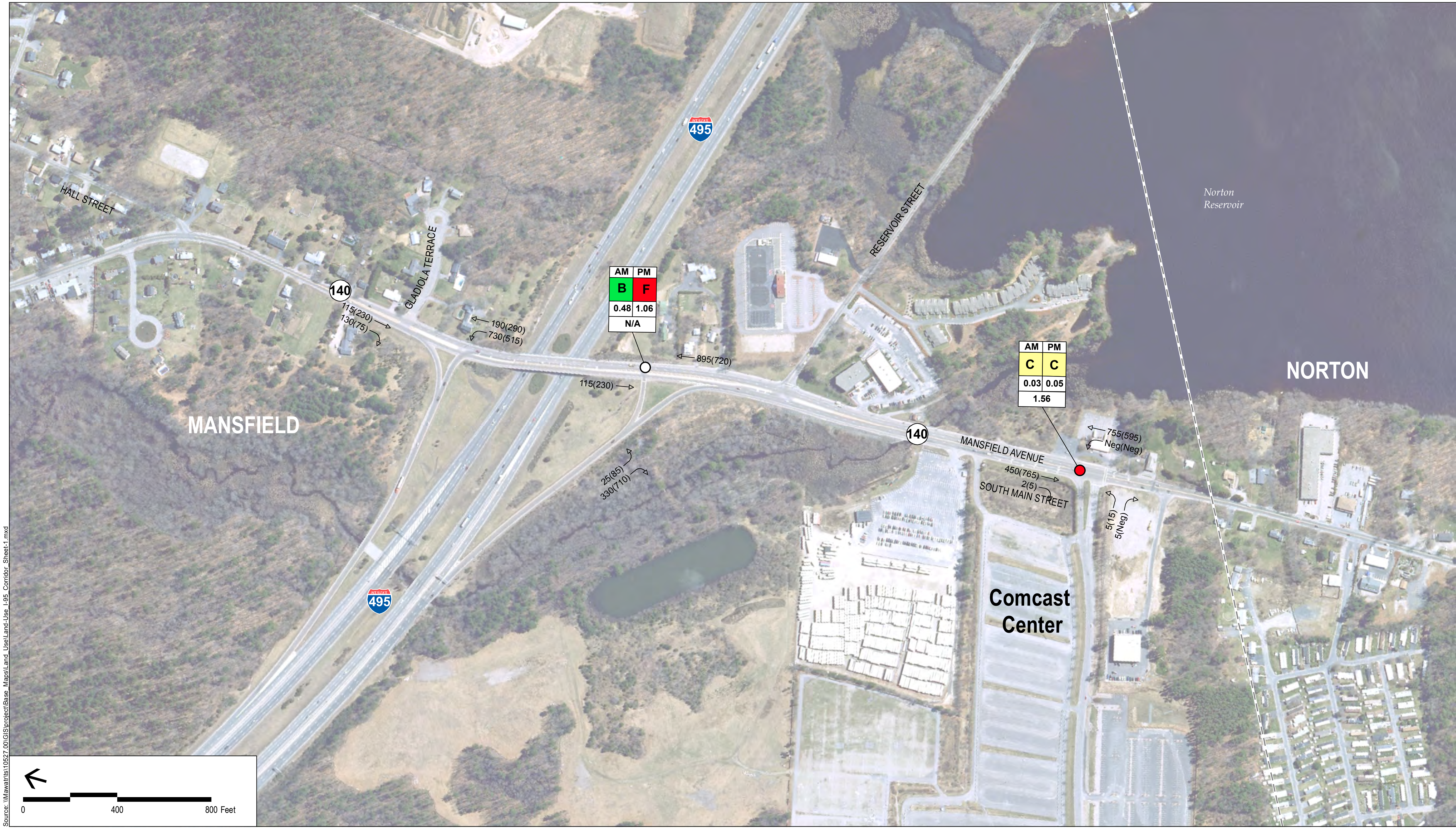
Figure 2-30

I-495 Interchange 12

Route 140 - Mansfield



Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

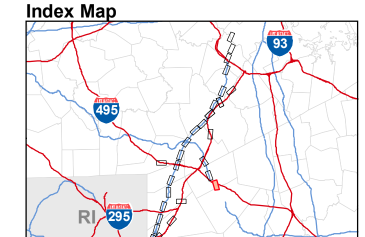


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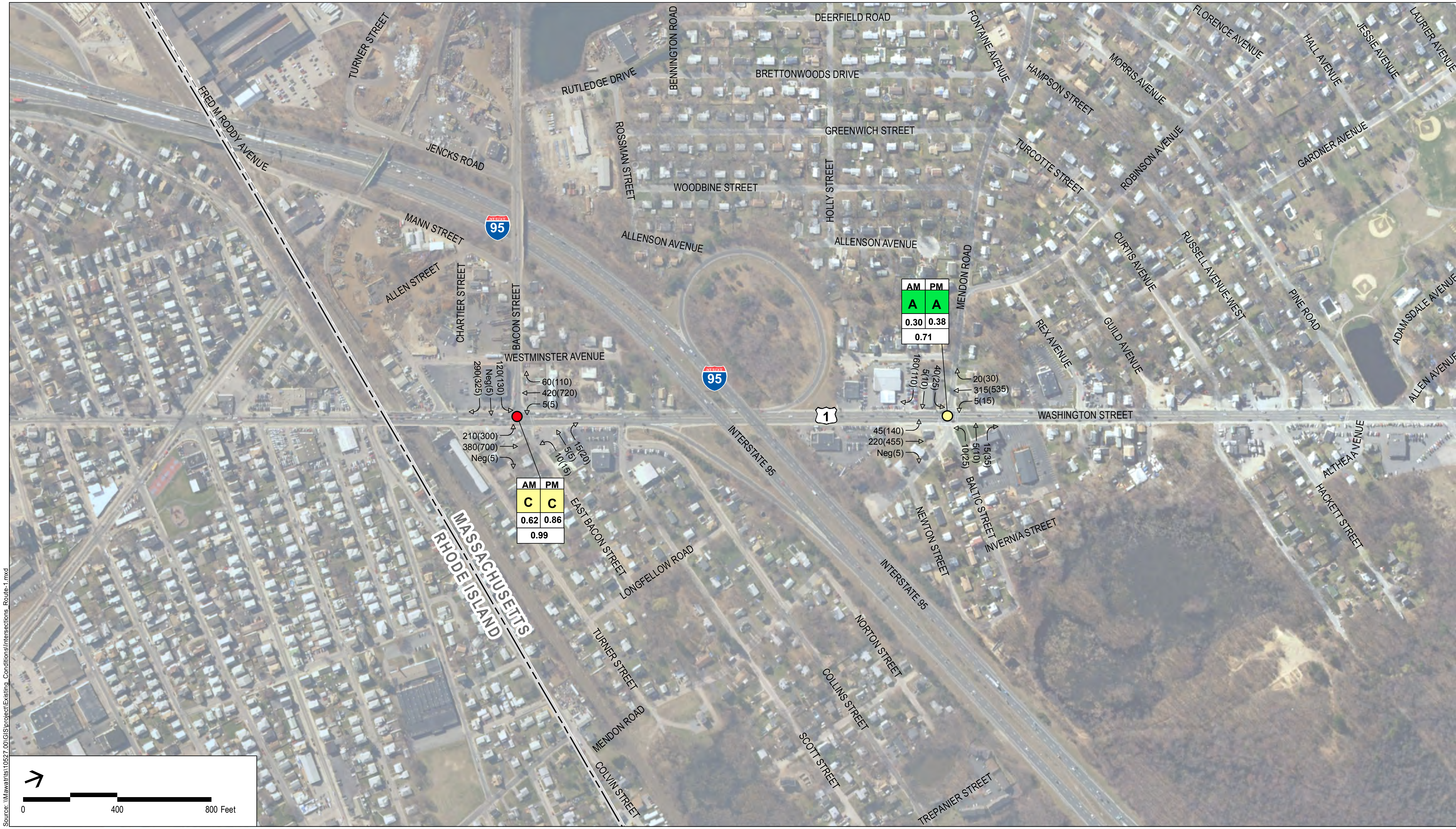
Figure 2-31

I-495 Interchange 11

Route 140 - Mansfield



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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

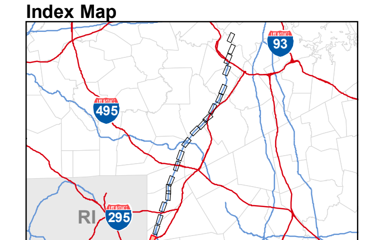

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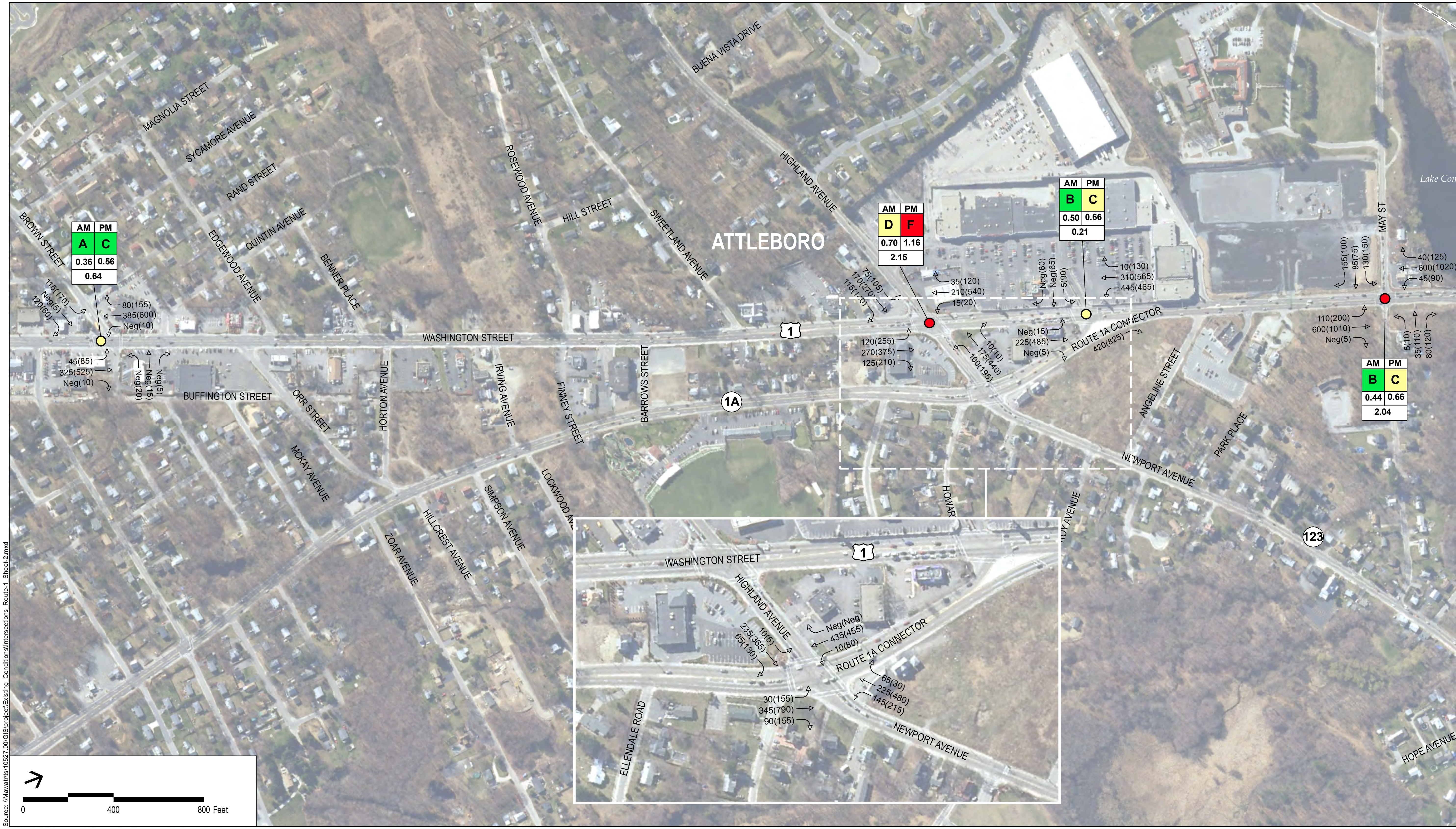
Figure 2-32

Existing Conditions - Route 1

Sheet 1 of 20



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massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

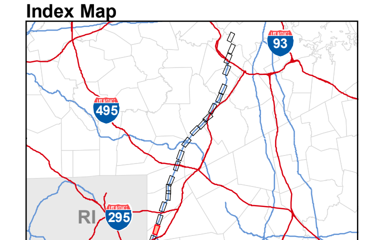
A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level
Exceeds MHD Average Crash Rate?
Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-33

Existing Conditions - Route 1

Sheet 2 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

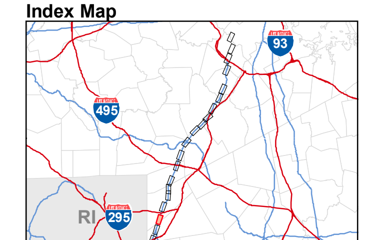
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-34

Existing Conditions - Route 1

Sheet 3 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

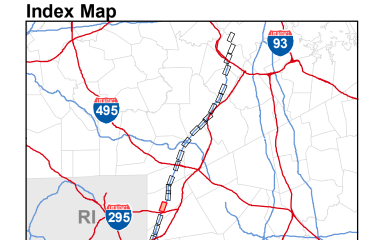
A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level
Exceeds MHD Average Crash Rate?
- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-35

Existing Conditions - Route 1

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massDOT
Moving Massachusetts Forward.
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B   C/D   E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

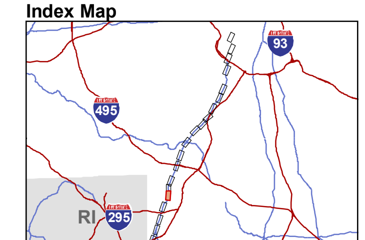
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

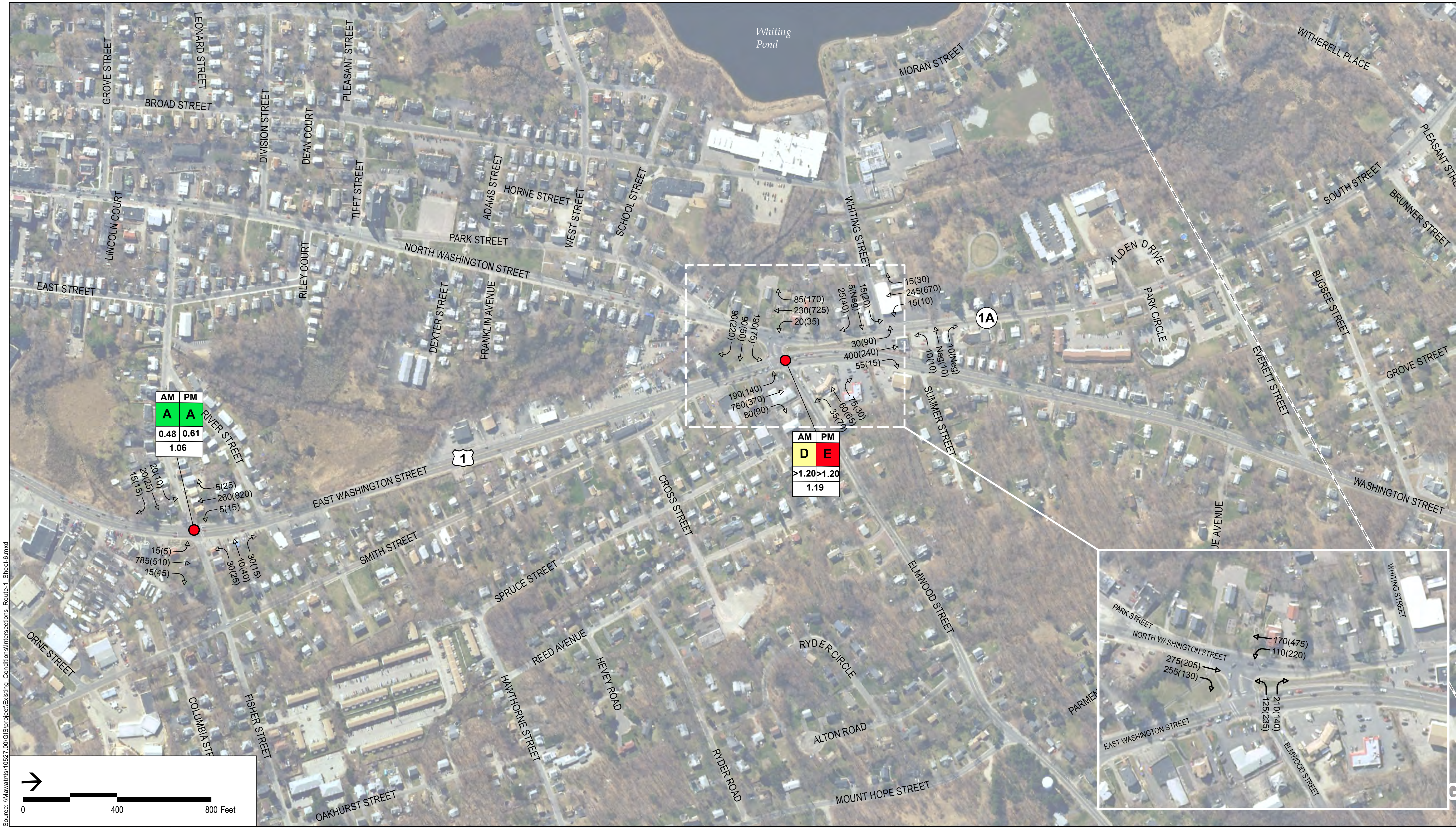


Vanasse Hangen Brustlin, Inc.

Figure 2-36

Existing Conditions - Route 1

Sheet 5 of 20



massDOT Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

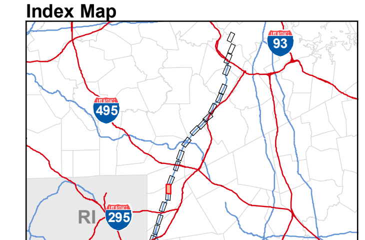
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-37

Existing Conditions - Route 1

Sheet 6 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM | PM
A | F — Level of Service
x.xx | x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

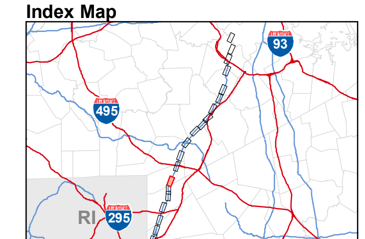
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map


Vanasse Hangen Brustlin, Inc.

Figure 2-38

Existing Conditions - Route 1

Sheet 7 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

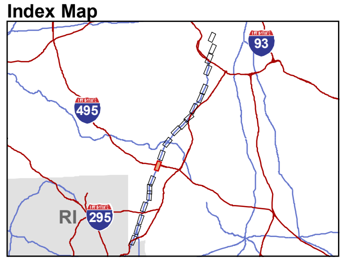
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-39

Existing Conditions - Route 1

Sheet 8 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

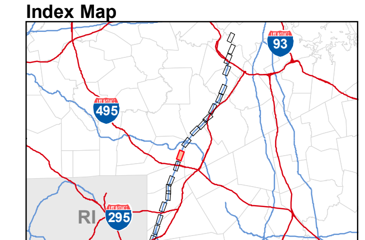
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-40

Existing Conditions - Route 1

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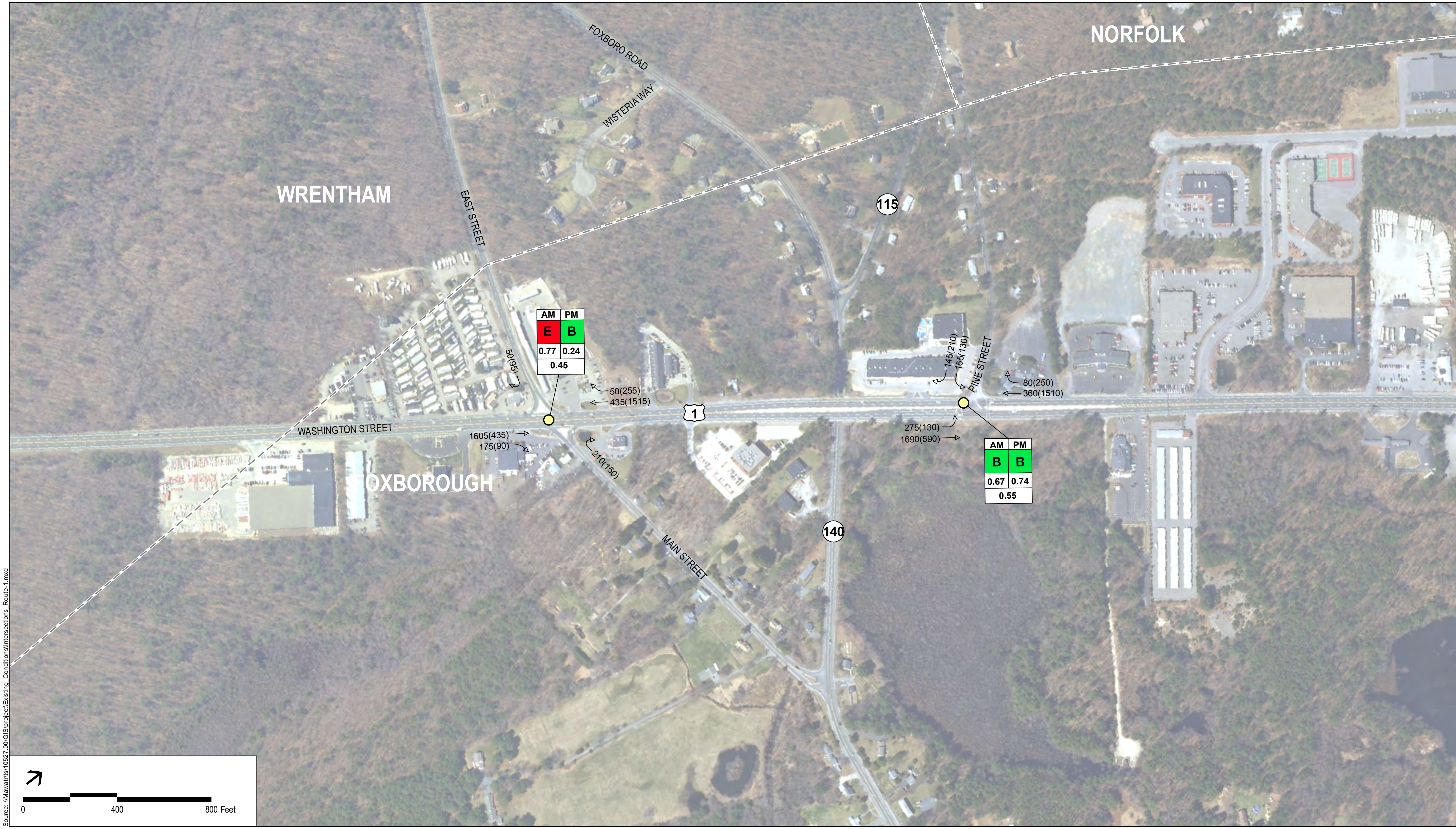


massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM PM — A/B — C/D — E/F
A F — Level of Service
x.xx x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

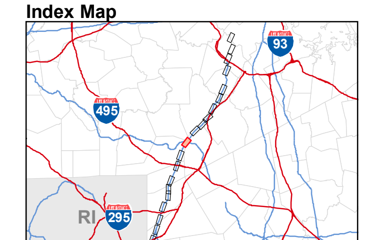
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-41

Existing Conditions - Route 1

Sheet 10 of 20

Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

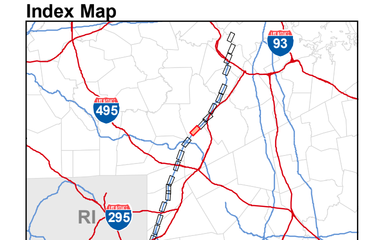
A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level
Exceeds MHD Average Crash Rate?
Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-42

Existing Conditions - Route 1

Sheet 11 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM PM
A F — Level of Service
x.xx x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level
Exceeds MHD Average Crash Rate?
Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

Vanasse Hangen Brustlin, Inc.

Figure 2-43

Existing Conditions - Route 1

Sheet 12 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

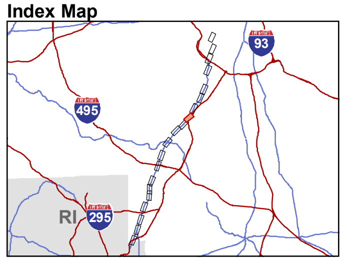
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-44

Existing Conditions - Route 1

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Source: \\Mawatr\ts\10527.00\GIS\project\Existing_Conditions\Intersections_Route-1.mxd

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

Vanasse Hangen Brustlin, Inc.

Figure 2-45

Existing Conditions - Route 1

Sheet 14 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

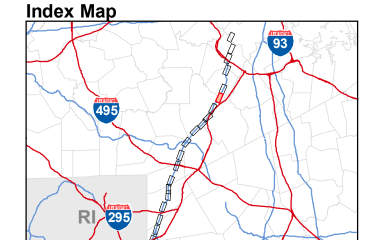
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

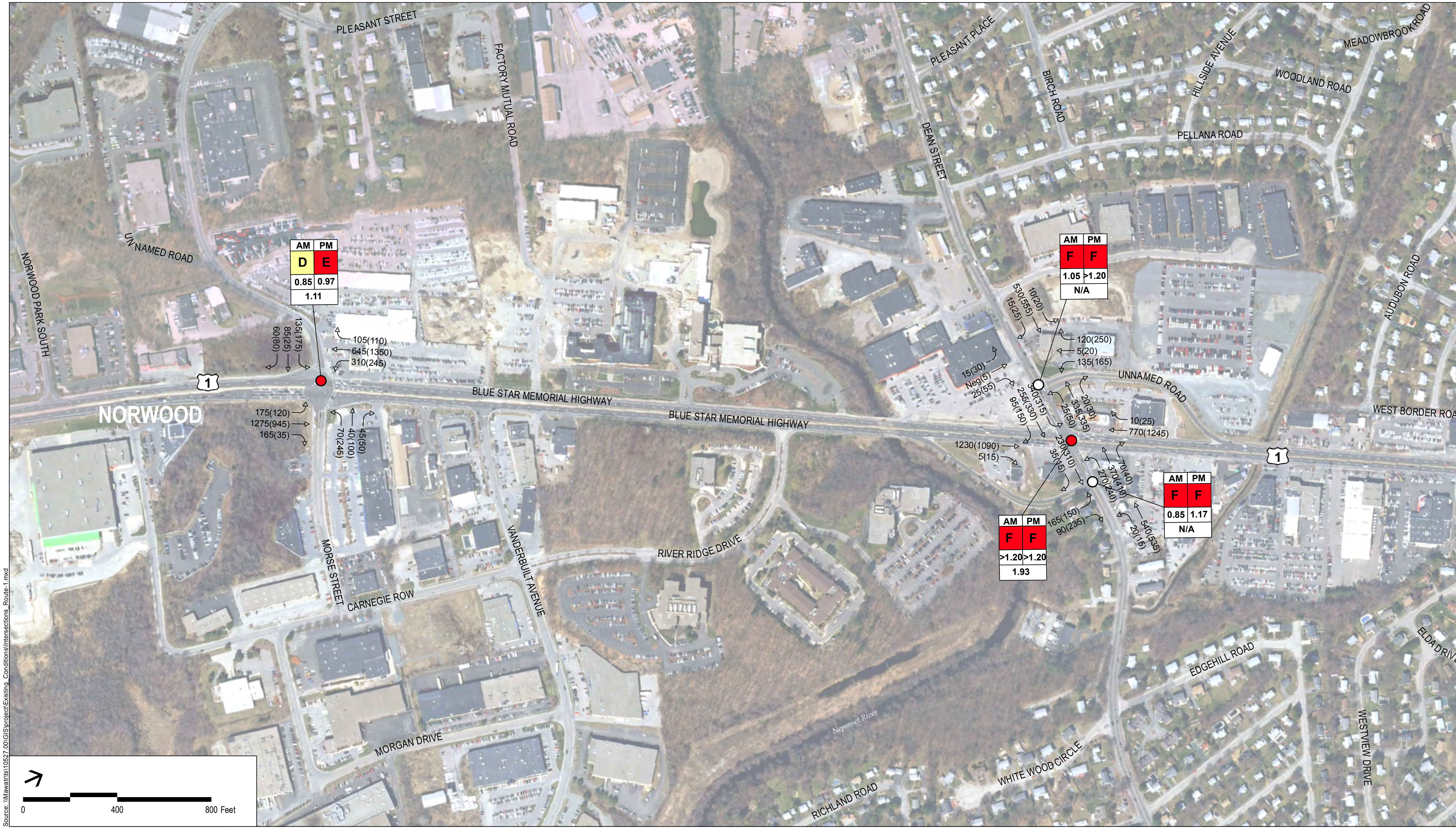


Vanasse Hangen Brustlin, Inc.

Figure 2-46

Existing Conditions - Route 1

Sheet 15 of 20



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massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM

(XX) - PM

Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

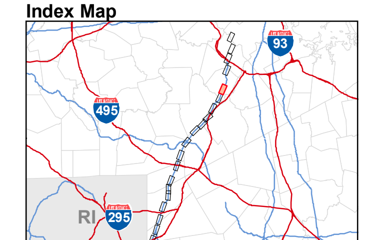
Yes

No

N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-47

Existing Conditions - Route 1

Sheet 16 of 20

Source: \\Mawatr\ts\10527.00\GIS\project\Existing_Conditions\Intersections_Route-1.mxd

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

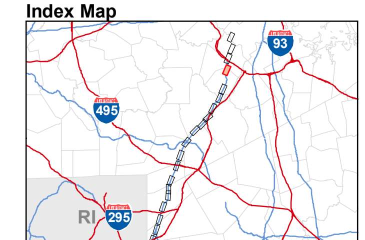
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

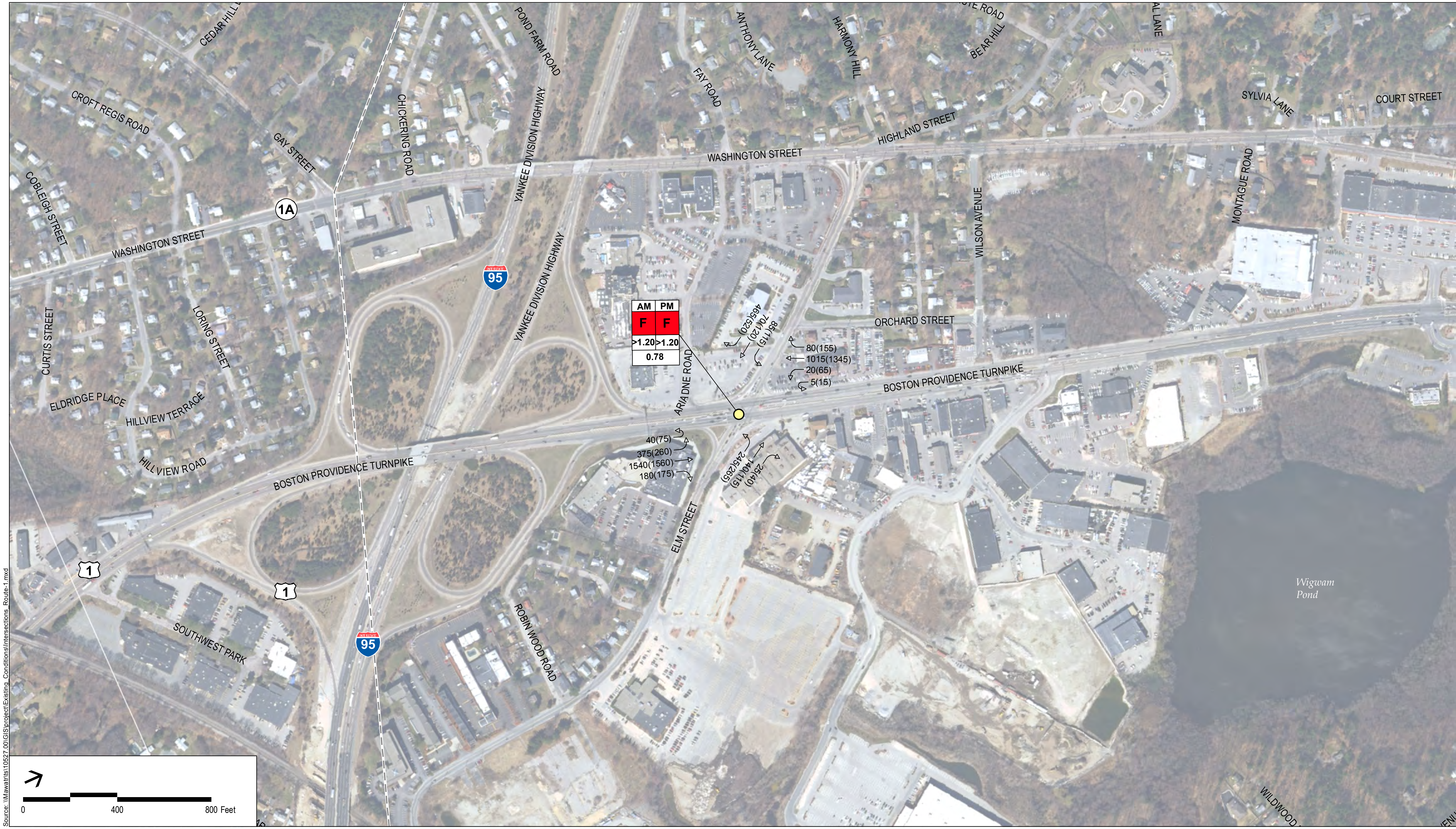


Vanasse Hangen Brustlin, Inc.

Figure 2-48

Existing Conditions - Route 1

Sheet 17 of 20



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

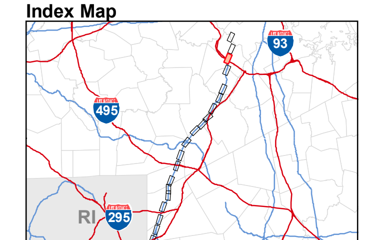
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-49

Existing Conditions - Route 1

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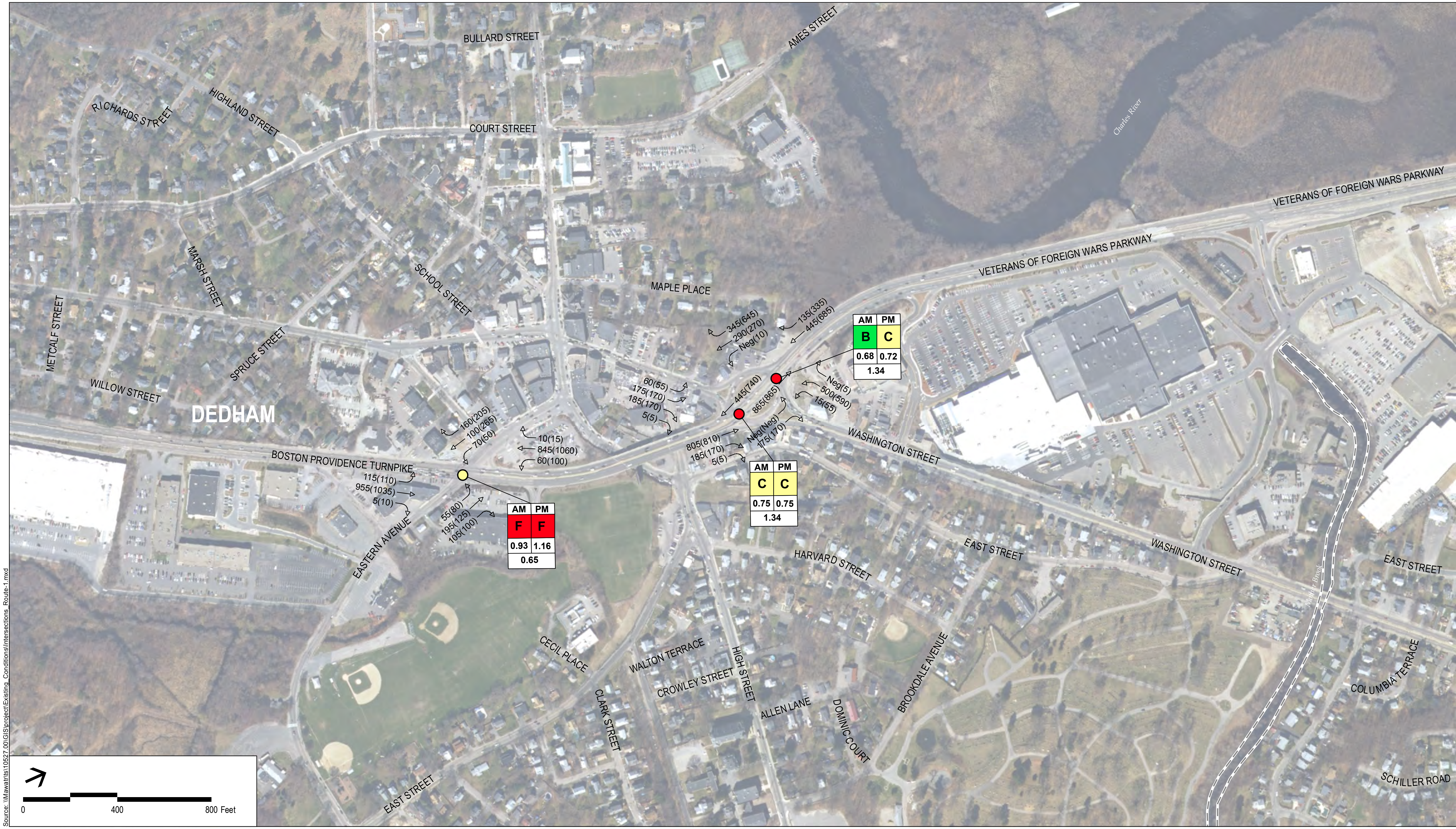


massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

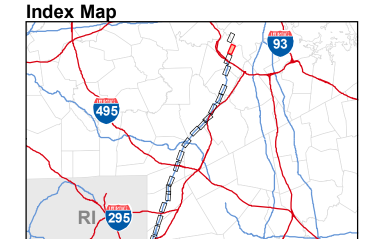
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-50

Existing Conditions - Route 1

Sheet 19 of 20

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

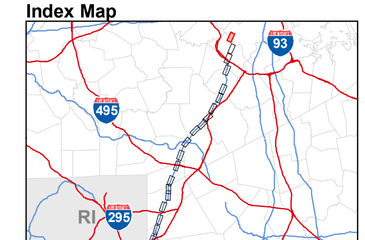
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 2-51

Existing Conditions - Route 1

Sheet 20 of 20

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2.4.3 Seasonal Variation

Based on a review of the I-495 Corridor Transportation Study recently completed by the Executive Office of Transportation Planning (precursor agency of MassDOT), it was determined that all traffic count data would be seasonally adjusted to reflect average weekday traffic volume conditions. Traffic data collection began in April 2008 and was completed in October 2008. MassDOT Statewide Traffic Data Collection was reviewed for the months of April through October to determine seasonal variation in traffic volumes associated with eastern interstates (includes I-95), I-495, and urban roadways during these months. Based on the assessment, these months' traffic volumes are higher than the statewide average month traffic volume level for eastern interstates, I-495, and urban and arterial collector roadways.

Further, a review of MassDOT continuous count station data for locations along I-95 and I-495 within the study area was reviewed for the months of April through October. Traffic volumes collected from April through October at all stations within the study area, with the exception of I-495 south of I-95, were found to be *higher* than the average month traffic volume levels for each station. Therefore, since the count data were found to be higher than annual average conditions for a more conservative analysis, no seasonal adjustments were applied to the data.

2.5 Safety Assessment

A safety analysis was conducted for the I-95, I-495 and Route 1 corridors within the study area limits to determine if the traffic demands being placed on the roadways combined with the geometric conditions of the roadways or ramps have resulted in potential safety concerns.

2.5.1 Methodology

To identify potential vehicle crash trends in the region, reported vehicular crash data for the study area roadways and intersections was obtained from MassDOT for the years 2004 through 2006, the most recent three-year history available.

For the mainline segments and interchanges, these data were summarized and crash trends were identified. For the study area intersections along the local roadway networks and Route 1, crash rates were calculated and compared to average crash rates for the area. Using the critical weekday peak-hour traffic volumes, combined with other traffic engineering data, and the number of crashes in the three-year total allows for the calculation of a crash rate at a given intersection. The calculation of an intersection's crash rate is an effective tool to measure and compare the relative safety of oneintersection to others. The crash rate calculation is expressed crashes per million entering vehicles (MEV), which is a standard in the traffic engineering profession that relates how many crashes occur at the intersection per one million vehicles that pass through the intersection. Rates that exceed MassDOT's average for crashes at intersections in the district in which the town or city is located (District 4 or District 5 for study area intersections) could indicate safety or geometric issues for a particular intersection and warrant further examination.

The 2005 MassDOT average crash rates for signalized and unsignalized intersections for District 5 (the MassDOT district designation for the majority of study area intersections) are 0.84 and 0.59, respectively. Boston and Dedham are located in MassDOT District 4. The 2005 MassDOT average crash rates for signalized and unsignalized intersections for District 4 are 0.88 and 0.63, respectively.

2.5.2 Vehicular Crash History

Mainline segments and interchanges along the I-95 corridor from the Rhode Island State Line to Interchange 12 (I-93/Route 128) and along the I-495 corridor from Interchange 15 (Route 1A) to Interchange 11 (Route 140) were reviewed. It should be noted that the location for many crashes at or near interchanges cannot be precisely determined from the database due in large part to how the vehicle crashes are reported and entered into the database. For instance, a crash record classified as "I-95 at Route 1 (Exit 1)" may have occurred at either the southbound off-ramp intersection or the northbound on-ramp intersection, or on the highway in close proximity to the ramps. Therefore, crashes recorded at interchanges were grouped and trends have been reported based on the total number of crashes at a given interchange.

Table 2-10 summarizes the observed crash trends along the mainline roadway segments along I-95 from the Rhode Island State Line to Interchange 12 (I-93/Route 128). Table 2-11 summarizes observed crash trends at the I-95 study area interchanges. This information is also summarized on the previous Figures 2-20 through 2-51 for each of the individual local street intersections at each of the interchanges and Route 1 intersections.

Table 2-10 Observed I-95 Mainline Crash Trends

I-95 Mainline Roadway Segment	Total Crashes (2004-2006)	Fatalities	Observed Trends
Rhode Island State Line to I/C 1	10	0	8 single vehicle crashes (80%) 7 crashes during rain/snow (70%)
I/C 1 to I/C 2	17	1 (I-95 SB)	7 single vehicle crashes (41%) 7 crashes on a roadway segment that is not lighted (41%)
I/C 2 to I/C 3	27	1 (I-95 NB)	15 single vehicle crashes (56%) 24 crashes on dry roadway surface (89%) 13 crashes on a roadway segment that is not lighted (48%)
I/C 3 to I/C 4	7	0	4 single vehicle crashes (57%) 4 crashes on a roadway segment that is not lighted (57%)
I/C 4 to I/C 5	23	0	15 rear-end crashes (65%) 19 crashes on dry roadway surface (83%) 8 crashes on a roadway segment that is not lighted (35%)
I/C 5 to I/C 6	70	0	29 rear-end crashes (41%) 56 crashes on dry roadway surface (80%) 20 crashes on a roadway segment that is not lighted (29%)
I/C 6 to I/C 7	10	0	5 single vehicle crashes (50%) 4 crashes on a roadway segment that is not lighted (40%)
I/C 7 to I/C 8	45	2 (I-95 SB)	19 rear-end crashes (42%) 36 crashes on dry roadway surface (80%) 16 crashes on a roadway segment that is not lighted (36%)
I/C 8 to I/C 9	29	3 (I-95 SB)	16 single vehicle crashes (55%) 24 crashes on dry roadway surface (83%) 11 crashes on a roadway segment that is not lighted (38%)
I/C 9 to I/C 10	23	0	12 single vehicle crashes (52%) 15 crashes on dry roadway surface (65%) 8 crashes on a roadway segment that is not lighted (35%)
I/C 10 to I/C 11	19	2 (I-95 NB)	9 single vehicle crashes (47%) 6 crashes on a roadway segment that is not lighted (32%)
I/C 11 to Dedham Slip Ramp	8	0	4 single vehicle crashes (50%) 2 crashes on a roadway segment that is not lighted (25%)
Dedham Slip Ramp to I/C 12	25	0	19 rear-end crashes (76%) 24 crashes on dry roadway surface (96%) 3 crashes on a roadway segment that is not lighted (12%)

Table 2-11 Observed I-95 Interchange Crash Trends

I-95 Interchange	Total Crashes (2004-2006)	Fatalities	Observed Trends
Exit 1 (Route 1)	31	0	15 total single vehicle crashes (48%) 20 total crashes on dry roadway surface (65%)
Exit 2 (Route 1A)	122	1 (I-95 NB at Exit 2)	73 total rear-end crashes (60%) 101 total crashes on dry roadway surface (83%) 15 total crashes on a roadway segment that is not lighted (12%)
Exit 3 (Route 123)	73	0	41 total rear-end crashes (56%) 56 total crashes on dry roadway surface (77%) 15 total crashes on a roadway segment that is not lighted (21%)
Exit 4 (I-295)	80	0	34 total single vehicle crashes (43%) 55 total crashes on dry roadway surface (69%) 17 total crashes on a roadway segment that is not lighted (21%)
Exit 5 (Toner Blvd)	144	1 (I-95 NB at Exit 5)	58 total rear-end crashes (40%); 45 total angle crashes (32%) 100 total crashes on dry roadway surface (69%) 27 total crashes on a roadway segment that is not lighted (19%)
Exit 6 (I-495)	136	1 (I-95 NB at Exit 6) 1 (I-95 SB at Exit 6)	58 total rear-end crashes (43%); 46 total angle crashes (34%) 108 total crashes on dry roadway surface (79%) 38 total crashes on a roadway segment that is not lighted (28%)
Exit 7 (Route 140)	63	0	32 total rear-end crashes (51%); 3 head-on crashes at Exit (30%) 46 total crashes on dry roadway surface (73%) 22 total crashes on a roadway segment that is not lighted (35%)
Exit 8 (Mechanic St / South Main St)	79	0	32 total single vehicle crashes (41%) 56 total crashes on dry roadway surface (71%) 21 total crashes on a roadway segment that is not lighted
Exit 9(Route 1)	97	2 (I-95 NB at Exit 9)	51 total rear-end crashes 69 total crashes on dry roadway surface 20 total crashes on a roadway segment that is not lighted (27%)
Exit 10(Coney St)	38	0	17 total rear-end crashes (45%) 32 total crashes on dry roadway surface (84%)
Exit 11(Neponset St)	98	0	54 total rear-end crashes (55%) 81 total crashes on dry roadway surface (83%) 17 total crashes on a roadway segment that is not lighted (17%)
Dedham Slip Ramp	3	0	2 rear-end crashes (67%)
Exit 12 (I-93 / Route 128)	168	1 (I-95 NB at Exit)	87 total rear-end crashes (52%) 129 total crashes on dry roadway surface (77%) 24 total crashes on a roadway segment that is not lighted (14%)

Source: MassDOT Crash Data
SB = Southbound; NB = Northbound

Table 2-12 summarizes observed crash trends along I-495 from Interchange 15 (Route 1A) to Interchange 11 (Route 140). Table 2-13 summarizes observed crash trends at the I-495 study area interchanges.

Table 2-12 Observed I-495 Mainline Crash Trends

I-495 Mainline Roadway Segment	Total Crashes (2004-2006)	Fatalities	Observed Trends
Exit 11 to Exit 12[1]	13	0	6 rear-end crashes (46%) 6 crashes on a roadway segment that is not lighted (46%)
Exit 12 to Exit 13	19	1 (I-495 SB)	9 single vehicle crashes (47%) 8 rear-end crashes (42%) 8 crashes on a roadway segment that is not lighted (42%)
Exit 13 to Exit 14	28	0	18 single vehicle crashes (64%) 18 crashes on dry roadway surface (64%) 9 crashes on a roadway segment that is not lighted (32%)
Exit 14 to Exit 15	31	1 (I-495 NB) 2 (I-495 SB)	22 single vehicle crashes (71%) 18 crashes on dry roadway surface (58%) 10 crashes on a roadway segment that is not lighted (32%)

Source: MassDOT Crash Data
Exit = Interchange; SB = Southbound; NB = Northbound
1 Crashes from Interchange 11 to Interchange 12 include crashes on the collector-distributor roadway

Table 2-13 Observed I-495 Interchange Crash Trends

I-495 Interchange	Total Crashes (2004-2006)	Fatalities	Observed Trends
Exit 11 and Exit 12 (Route 140)	66	0	26 total rear-end crashes (39%) 20 total single vehicle crashes (30%) 56 total crashes on dry roadway surface (85%) 21 total crashes on a roadway segment that is not lighted (32%)
Exit 14 (Route 1)	67	0	36 total single vehicle crashes (54%) 44 total crashes on dry roadway surface (66%) 16 total crashes on a roadway segment that is not lighted (24%)
Exit 15 (Route 1A)	146	1 (I-495 NB at Exit 15)	57 total rear-end crashes (39%) 96 total crashes on dry roadway surface (66%) 22 total crashes on a roadway segment that is not lighted (15%)

Source: MassDOT Crash Data
Note: Interchange 13 data included in Table 2-11 as I-95 Interchange 6.
Exit = Interchange; SB = Southbound; NB = Northbound

A safety assessment was also conducted for the key intersections in the study area. A summary of the vehicle crash history at study intersections along the local access road to I-95 and I-495 is presented in Table 2-14. These crash rates are also presented graphically in the existing conditions figures for each of the interchanges along I-95 and for I-495. A summary of the vehicle crash history at the Route 1 study intersections is presented in Table 2-15.

As shown in the tables below, many of the intersections in the study area experience crash rates higher than the MassDOT average crash rate for the similarly controlled intersection in the same district (District 4 or District 5, as appropriate). Eight of these intersections are on the 2006 statewide top 200 intersection crash list (see below).

At the study area intersections, there were a total of three fatal accidents over the three-year period.

Eight study area intersections are on the 2004-2006 Statewide top 200 intersection crash list. This list was compiled by MassDOT under the authority of United States Code Title 23, Section 148, Highway Safety Improvement Program, sponsored by the Federal Highway Administration. Table 2-16 presents the list of study area intersections on the statewide top 200 intersection crash list and their respective rankings.

Table 2-16 Study Area Intersections in Statewide Top 200 Intersection Crash List

Rank	City/Town	Street 1	Street 2
29	Plainville	Washington Street (Route 1)	Taunton Street (Route 152)
55	Attleboro	Washington Street (Route 1)	May Street
88	Norwood	Blue Star Memorial Highway (Route 1)	Dean Street
99	Walpole	Providence Turnpike (Route 1)	High Plan Street (Route 27)
142	Attleboro	Highland Avenue (Route 123)	Washington Street (Route 1)
146	North Attleborough	East Washington Street (Route 1)	Chestnut Street
162	Walpole	Providence Turnpike (Route 1)	Coney Street
203	North Attleborough	South Washington Street	East Washington Street (Route 1)/ Hoppin Hill Avenue (Route 120)

Source: 2006 Top 200 Crash Locations Report, July 2008

The methodology for the analysis is presented in the July 2008, *2006 Top Crash Locations Report*[1]. The methodology is based on Equivalent Property Damage Only (EPDO) weighting to rank the clusters of accidents around each respective intersection. Under this weighting system, fatal crashes are weighted as 10, injury crashes are weighted as 5 and property damage only and non-reported severity is weighted as 1.

2.5.3 Roadside Safety Audit

As part of an unrelated study conducted by MassDOT for the I-95 corridor, a Roadside Safety Audit was conducted along the southern portion of I-95 south of I-495. This effort focused on roadside clearances, crash tendencies, and summarized likely causes and influences of these crash trends. A draft copy of the Audit is attached to this study for reference purposes.

In summary, the study found that there are a number of cross-median crashes occurring along certain sections of the corridor and presented several possible solutions for consideration. These will be explored in the development of the alternatives in the future sections of this report.

1 2006 Top 200 Crash Locations Report, July 2008; http://www.mhd.state.ma.us/downloads/trafficMgmt/06TopCrashLocationsRpt.pdf

Table 2-14 I-95 and I-495 Local Roadway Vehicular Crash Summary: 2004 to 2006

	I-95 Exit 1	I-95 Exit 2	I-95 Exit 3	I-95 Exit 5				I-95 Exit 7			I-95 Exit 8	I-95 Exit 10	I-95 Exit 11	I-495 Exit 11/12		I-495 Exit 15
	Route 1 at Scott Street	Route 1A at MBTA driveway/ Bristol Place	Route 123 at Lathrop Drive	Toner Blvd. at North Ave/ Burden Ave.	Toner Blvd. at Triboro Plaza	Toner Blvd. at John Dietsch Blvd.	Toner Blvd. at Route 152	Route 140 at Fisher Street	Route 140 at Forbes Blvd.	Route 140 at Walnut Street	Mechanic Street at Oak Street	Coney Street at Rustic Road	Neponset Street at Wedgewood Drive	Route 140 at Comcast Center driveway	Route 140 at School Street	Route 1A at Premium Outlet Blvd.
Signalized?	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes
MassDOT District	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5
MassDOT Average Crash Rate	0.59	0.59	0.59	0.84	0.84	0.84	0.84	0.84	0.84	0.59	0.84	0.59	0.84	0.59	0.84	0.84
MassDOT Calculated Crash Rate	1.66	0.78	0.79	0.83	0.32	0.44	1.07	0.37	1.24	0.55	1.10	0.12	0.51	1.56	1.25	0.70
Exceeds?	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No
Year																
2004	10	9	4	2	0	6	10	2	19	2	2	0	2	10	12	8
2005	10	17	8	7	0	1	11	10	14	8	8	1	6	9	19	9
2006	8	11	10	11	7	3	12	3	19	2	3	1	5	8	21	4
Total	28	37	22	20	7	10	33	15	52	12	13	2	13	27	52	21
Collision Type																
Angle	17	11	11	3	4	6	4	1	17	4	1	2	1	7	21	11
Head-on	1	0	0	3	0	0	0	0	0	0	0	0	0	1	1	2
Rear-end	7	17	6	7	3	4	22	11	27	2	8	0	11	12	23	4
Rear-to-Rear	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0
Sideswipe	2	6	1	5	0	0	3	1	3	1	1	0	0	4	4	4
Single-vehicle crash	0	0	3	2	0	0	2	1	2	4	0	0	0	2	2	0
Unknown	1	3	1	0	0	0	2	0	3	1	2	0	1	0	1	0
Total	28	37	22	20	7	10	33	15	52	12	13	2	13	27	52	21
Severity																
Fatality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Injury	7	11	4	5	2	1	8	3	17	1	1	1	5	10	6	8
Property-related	18	23	18	10	5	7	24	11	32	11	11	1	7	17	45	12
Unknown	3	3	0	5	0	2	1	1	3	0	1	0	1	0	1	1
Total	28	37	22	20	7	10	33	15	52	12	13	2	13	27	52	21
Time of day																
Weekday, 7:00 AM - 9:00 AM	2	4	4	1	0	1	9	3	6	3	3	0	3	0	7	1
Weekday, 4:00 PM - 6:00 PM	7	4	3	5	1	4	3	6	13	0	2	1	3	7	9	2
Saturday, 11:00 AM - 2:00 PM	1	0	2	0	1	0	1	0	2	0	1	0	0	0	0	1
Weekday, other time	14	22	12	11	5	4	15	3	22	8	6	1	5	10	29	11
Weekend, other time	4	7	1	3	0	1	5	3	9	1	1	0	2	10	7	6
Total	28	37	22	20	7	10	33	15	52	12	13	2	13	27	52	21
Pavement Conditions																
Dry	17	31	15	18	3	8	23	11	44	8	10	2	9	22	39	17
Wet	10	4	4	1	3	0	3	4	7	3	1	0	4	4	11	4
Snow	0	1	3	0	0	1	4	0	1	1	0	0	0	0	1	0
Ice/Slush	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0
Unknown	0	1	0	0	1	1	3	0	0	0	0	0	0	0	1	0
Total	28	37	22	20	7	10	33	15	52	12	13	2	13	27	52	21

source: MassDOT crash data
n/a Crash rates were not able to be calculated for intersection.
1 Location consists of a rotary.

Table 2-15 Route 1 Vehicular Crash Summary: 2004 to 2006

	Route 1 (Boston) at	Route 1 (Dedham) at			Route 1 (Norwood) at					Route 1 (Walpole) at			Route 1 (Sharon) at	Route 1 (Foxborough) at			
	Route 109	Washington Street1	Eastern Avenue	Elm Street	Everett Street / University Ave	Dean Street	Morse Street	Sumner Street	Union Street	Coney Street	Route 27	Pine Street	Old Post Road	North Street / Water Street	Patriot Place2	Pine Street	East Street / Main Street
Signalized?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
MassDOT District	District 4	District 4	District 4	District 4	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5
MassDOTAverage Crash Rate	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.59
MassDOT Calculated Crash Rate	0.65	1.34	0.65	0.78	0.69	1.93	1.11	0.75	0.55	1.40	1.61	0.60	0.36	0.45	n/a	0.55	0.45
Exceeds?	No	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes	No	No	No	n/a	No	No
Year																	
2004	9	9	11	13	17	27	19	14	7	17	25	7	4	8	4	7	4
2005	13	11	5	19	13	28	10	9	9	24	21	9	5	1	9	6	4
2006	15	35	9	14	11	34	18	8	6	19	32	5	5	9	9	6	6
Total	37	55	25	46	41	89	47	31	22	60	78	21	14	18	22	19	14
Collision Type																	
Angle	15	22	10	9	12	40	7	5	11	19	21	9	5	7	4	1	2
Head-on	0	0	1	1	0	0	0	2	0	3	1	1	1	2	2	0	1
Rear-end	14	18	8	31	22	31	31	16	9	32	39	5	4	4	5	12	9
Sideswipe	3	6	1	4	2	7	2	3	0	3	10	2	4	0	3	5	0
Single-vehicle crash	1	3	2	0	2	3	6	3	1	1	2	4	0	3	6	0	1
Unknown	4	6	3	1	3	8	1	2	1	2	5	0	0	2	2	1	1
Total	37	55	25	46	41	89	47	31	22	60	78	21	14	18	22	19	14
Severity																	
Fatality	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Injury	9	12	9	22	12	29	21	12	7	17	18	6	7	5	4	4	3
Property-related	21	30	10	22	24	53	24	18	12	37	53	9	6	12	17	14	10
Unknown	7	13	6	2	5	7	2	1	2	6	7	6	1	1	0	1	0
Total	37	55	25	46	41	89	47	31	22	60	78	21	14	18	22	19	14
Time of day																	
Weekday, 7:00 AM - 9:00 AM	4	4	3	4	4	8	4	2	6	4	13	0	3	2	3	0	3
Weekday, 4:00 PM - 6:00 PM	5	8	2	6	4	13	5	2	9	9	13	3	0	1	2	0	2
Saturday, 11:00 AM - 2:00 PM	1	6	0	0	0	4	0	0	0	2	2	0	0	0	0	1	0
Weekday, other time	23	31	11	25	25	42	32	24	3	31	35	11	9	11	10	14	6
Weekend, other time	4	6	9	11	8	22	6	3	4	14	15	7	2	4	7	4	3
Total	37	55	25	46	41	89	47	31	22	60	78	21	14	18	22	19	14
Pavement Conditions																	
Dry	35	33	18	33	30	70	37	24	13	41	54	17	11	16	17	16	13
Wet	2	19	6	9	10	14	7	7	7	14	20	2	3	2	4	2	1
Snow	0	0	0	1	1	2	1	0	2	1	1	2	0	0	0	1	0
Ice	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	0	0
Other	0	3	1	2	0	3	2	0	0	2	2	0	0	0	1	0	0
Total	37	55	25	46	41	89	47	31	22	60	78	21	14	18	22	19	14

source: MassDOT crash data
n/a Crash rates were not able to be calculated for intersection.
1 Location consists of a rotary.
2 Multiple intersections with the same name. Data could not be separated for study area intersection and crash rate was not calculated.

Table 2-15 Route 1 Vehicular Crash Summary: 2004 to 2006 (cont.)

	Route 1 (Wrentham) at		Route 1 (Plainville) at		Route 1 (North Attleborough) at									Route 1 (Attleboro) at					
	Thurston Street	Madison Street	Route 152 / Taunton Street	Route 106	Route 1A / Elmwood Street	Fisher Street	Landry Avenue / Orne Street	Elm Street	Chestnut Street	Route 120 (Hoppin Hill Avenue)	Draper Avenue	Allen Avenue	Cumberland Avenue	May Street	Route 1A	Route 123	Brown Street	Mendon Road	Bacon Street
Signalized?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MassDOT District	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5	District 5
MassDOTAverage Crash Rate	0.84	0.59	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
MassDOT Calculated Crash Rate	1.04	0.38	2.14	0.70	1.19	1.06	0.94	1.43	1.88	2.29	1.12	0.90	0.30	2.04	0.21	2.15	0.64	0.71	0.99
Exceeds?	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes
Year																			
2004	8	4	18	1	7	6	4	19	17	26	17	11	3	21	2	28	4	5	6
2005	9	3	26	11	9	9	9	17	16	22	9	8	5	35	5	20	6	5	13
2006	7	3	27	7	12	5	8	6	21	33	9	10	2	19	0	22	3	2	9
Total	24	10	71	19	28	20	21	42	54	81	35	29	10	75	7	70	13	12	28
Collision Type																			
Angle	11	2	21	5	8	7	7	22	26	13	13	9	6	34	1	35	7	8	11
Head-on	1	1	2	1	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1
Rear-end	6	4	32	8	14	8	9	13	15	25	14	15	3	35	4	21	1	2	11
Sideswipe	1	1	9	3	3	1	2	4	3	1	4	2	1	5	2	9	3	0	3
Single-vehicle crash	5	2	0	2	0	1	2	1	3	38	2	0	0	0	0	1	1	0	1
Unknown	0	0	7	0	2	3	1	1	6	4	2	2	0	1	0	3	1	1	1
Total	24	10	71	19	28	20	21	42	54	81	35	29	10	75	7	70	13	12	28
Severity																			
Fatality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Injury	12	3	30	7	7	7	9	13	15	21	9	6	2	23	2	14	2	9	10
Property-related	12	7	35	10	19	13	10	27	32	50	19	20	8	50	4	54	11	2	18
Unknown	0	0	6	2	2	0	2	2	7	10	7	3	0	2	1	2	0	1	0
Total	24	10	71	19	28	20	21	42	54	81	35	29	10	75	7	70	13	12	28
Time of day																			
Weekday, 7:00 AM - 9:00 AM	2	1	12	5	2	1	2	2	3	4	5	1	0	6	2	4	0	0	2
Weekday, 4:00 PM - 6:00 PM	5	1	5	1	7	5	3	7	7	7	2	1	0	8	1	3	2	3	3
Saturday, 11:00 AM - 2:00 PM	0	1	3	3	2	0	0	1	4	0	6	2	0	3	0	5	1	0	1
Weekday, other time	11	6	34	7	14	13	11	23	26	42	14	18	7	40	4	45	7	9	15
Weekend, other time	6	1	17	3	3	1	5	9	14	28	8	7	3	18	0	13	3	0	7
Total	24	10	71	19	28	20	21	42	54	81	35	29	10	75	7	70	13	12	28
Pavement Conditions																			
Dry	18	7	50	14	17	12	15	37	45	53	26	19	8	58	7	53	9	10	20
Wet	4	2	20	4	6	6	5	5	7	25	6	8	1	13	0	15	4	2	7
Snow	2	0	0	1	3	0	1	0	0	0	1	1	1	2	0	1	0	0	0
Ice	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Other	0	1	1	0	2	2	0	0	2	3	2	0	0	2	0	1	0	0	1
Total	24	10	71	19	28	20	21	42	54	81	35	29	10	75	7	70	13	12	28

source: MassDOTcrash data
n/a Crash rates were not able to be calculated for intersection.

2.6 Existing Traffic Operations

The next step in the study process was to evaluate the operations of the study area roadway system. This analysis provides a technical assessment of the operational qualities of the freeway segments, ramps, weaving segments, and intersections using the procedures outlined in the 2000 Highway Capacity Manual (HCM)[2]. The traffic analysis was conducted using the 2008 weekday morning and weekday evening peak hour traffic volumes and the geometric design conditions as they currently exist along the study area roadways. The relationship between the supply and demand on a roadway is fundamental in evaluating how well a transportation facility fulfills its objective to safely and efficiently accommodate the travelling public.

The supply and demand on a facility is fundamental in evaluating how well it fulfills its objective to safely and efficiently accommodate the traveling public. To quantify this supply/demand relationship, the traffic engineering profession uses "level-of-service" as the qualitative measurement denoting the different operating conditions that occur under various traffic volume loadings. Level-of-service incorporates a number of factors including roadway geometrics, vehicular speeds, delay, freedom to maneuver, and safety. Level-of-service (LOS) designations are assigned to specific locations and range from A to F. LOS A represents the best operating condition with free flow and minimal delay. LOS F represents the worst condition with congestion and long delays. LOS A through D are typically considered desirable conditions for urban intersections by state and local transportation agencies. LOS E and F conditions are often considered to be undesirable, although frequently encountered in urban settings.

2.6.1 Basic Freeway Segment Operations

The capacity of basic freeway segments was analyzed using procedures outlined in Chapter 23, Basic Freeway Segments, of the HCM. According to the HCM, a six or eight-lane highway can process approximately 2,400 passenger vehicles per lane per hour under optimal operating conditions. This optimal capacity is influenced by a number of factors including the amount of heavy vehicles such as trucks, buses or recreational vehicles within the traffic stream, the terrain, lane widths, the presence of obstructions adjacent to the roadway, the composition of the driver population (commuters who are familiar with the roadway or infrequent users), and the prevailing speed of the traffic flow.

Three measures provide an indication of how well traffic flow is accommodated by a freeway segment. These measures include density of passenger cars per mile per lane of roadway, average speed of passenger cars, and volume to capacity ratio. These measures are interrelated but the primary measure used to provide an estimate of level of service is density. As the density of vehicles per mile of roadway increases, the speed and flow rate tend to decrease while the level of service declines. The term level-of-service is used to define the operational characteristics of traffic flow along a given roadway. A letter grade from LOS A (representing free-flow traffic conditions) to LOS F (representing an unacceptable level of congestion) is assigned to a specific segment of the roadway. Table 2-17 and accompanying Figure 2-52 present the criteria for freeway segment level of service.

2 Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2000.

Table 2-17 Freeway Level of Service Criteria

Level of Service	Freeway Density[1]
A	0 to 11
B	> 11 to 18
C	> 18 to 26
D	> 26 to 35
E	> 35 to 45
F	> 45

Source: Transportation Research Board, Highway Capacity Manual (HCM 2000), (Washington, DC).
1 Density is expressed in passenger cars per mile per lane

The results of the basic freeway segment analysis for I-95 and I-495 under morning and evening peak hour conditions are summarized in Table 2-18 and Table 2-19, respectively. The results are also presented graphically in the existing conditions figures (shown previously) for the I-95 and I-495 corridors. Capacity analysis worksheets for basic freeway segments are included in the Appendix. Note that the interchange of I-93/I-95 is currently undergoing its own separate evaluation as part of an MassDOT study. Key results include:

I-95 Northbound - During the morning peak hour, four of the 14 segments operate under congested conditions (LOS E). These four segments are generally located from the Toner Boulevard/Route 152 (Exit 5) on-ramp to Route 1 (Exit 9) off-ramp. Four additional segments along I-95 northbound operate at LOS D during the morning peak hour. During the evening peak hour, the northbound direction of I-95 is generally operating at acceptable levels within the study area (all segments operate at LOS C or better).

I-95 Southbound - During the morning peak hour, all segments of I-95 southbound within the study area operate at LOS C or better. During the evening peak hour, four of the 15 segments of I-95 southbound operate under congested conditions (LOS E):

- Two segments of I-95 southbound from Dedham Street on-ramp (Slip Ramp) to Coney Street off-ramp (Exit 10);
- The segment of I-95 southbound from Route 1 on-ramp (Exit 9) to South Main Street off-ramp (Exit 8); and
- The segment of I-95 southbound from I-495 on-ramp (Exit 6) to Toner Boulevard/ Route 162 off-ramp (Exit 5).

Five additional segments along I-95 southbound operate at LOS D during the evening peak hour.

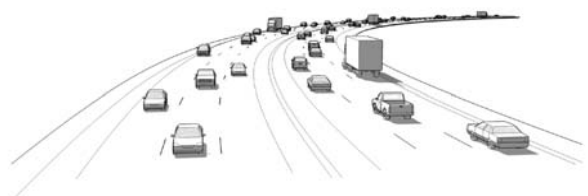
I-495 Northbound - During both the morning and evening peak hours, all segments of I-495 northbound within the study area operate at LOS C or better.

I-495 Southbound -- During both the morning and evening peak hours, all segments of I-495 southbound within the study area operate at LOS C or better.

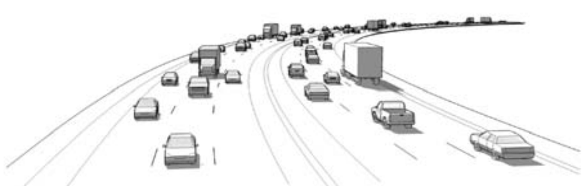
LOS A
- Free-flow operation

LOS B
- Reasonably free-flow
- Ability to maneuver is only slightly restricted
- Effects of minor incidents still easily absorbed

LOS C
- Speeds at or near free-flow
- Freedom to maneuver is noticeably restricted
- Queues may form



LOS D
- Speeds decline slightly with increasing flows
- Freedom to maneuver is more noticeably limited
- Minor incidents create queuing



LOS E
- Operation near or at capacity with no usable gaps
- Operations extremely volatile
- Any disruption causes queuing

LOS F
- Breakdown in flow
- Queues form behind breakdown points
- Demand is greater than capacity

massDOT

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Figure 2-52

Level of Service Descriptions

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs

Table 2-18 I-95 Freeway Segment Capacity Analyses Summary — 2008 Existing Conditions

I-95 Northbound								I-95 Southbound							
Freeway Segment Description		Weekday Morning Peak Hour			Weekday Evening Peak Hour			Freeway Segment Description		Weekday Morning Peak Hour			Weekday Evening Peak Hour		
From	To	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	From	To	Volume	Density	LOS	Volume	Density	LOS
RI State Line	Exit 1	3,600	20.7	C	3,300	19.0	C	Exit 12	Slip Ramp	2,950	17.0	B	5,200	31.1	D
Exit 1	Exit 2	3,900	22.4	C	3,500	20.2	C	Slip Ramp	Exit 11	3,050	17.6	B	6,100	41.3	E
Exit 2	Exit 3	4,100	23.6	C	3,250	18.7	C	Exit 11	Exit 10	3,050	17.5	B	6,100	40.9	E
Exit 3	Exit 4	4,300	24.7	C	3,150	18.0	B	Exit 10	Exit 9	2,650	15.3	B	5,500	33.9	D
Exit 4	Exit 5	5,650	34.8	D	4,150	23.7	C	Exit 9	Exit 8	2,800	16.1	B	5,900	38.4	E
Exit 5	Exit 6	6,050	40.6	E	4,000	23.0	C	Exit 8	Exit 7	3,000	17.3	B	5,600	34.9	D
Exit 6	Exit 7	6,050	39.3	E	3,400	19.3	C	Exit 7	Exit 6	3,100	17.6	B	5,650	34.5	D
Exit 7	Exit 8	5,850	37.8	E	3,350	19.3	C	Exit 6	Exit 5	3,700	21.3	C	5,900	38.4	E
Exit 8	Exit 9	6,000	39.8	E	3,150	18.1	C	Exit 5	Exit 4	3,800	21.7	C	5,650	34.8	D
Exit 9	Exit 10	5,150	30.7	D	3,050	17.6	B	Exit 4	Exit 3	2,900	16.6	B	3,800	21.8	C
Exit 10	Exit 11	5,550	34.1	D	3,400	19.5	C	Exit 3	Exit 2	2,950	17.0	B	3,550	20.4	C
Exit 11	Exit 12	4,950	29.1	D	3,250	18.7	C	Exit 2	Exit 1	3,250	18.7	C	3,400	19.6	C
								Exit 1	RI State Line	3,150	18.1	C	3,200	18.4	C

Source: VHB, Inc. using HCS2000 methodologies.
Noted: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).

Table 2-19 I-495 Freeway Segment Capacity Analyses Summary — 2008 Existing Conditions

I-495 Northbound								I-495 Southbound							
Freeway Segment Description		Weekday Morning Peak Hour			Weekday Evening Peak Hour			Freeway Segment Description		Weekday Morning Peak Hour			Weekday Evening Peak Hour		
From	To	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	From	To	Volume	Density	LOS	Volume	Density	LOS
Exit 10	Exit 11	3,600	20.7	C	3,600	20.7	C	Exit 16	Exit 15	3,600	20.7	C	3,600	20.7	C
Exit 11	Exit 12	3,000	17.3	B	3,200	18.4	C	Exit 15	Exit 14	3,650	21.0	C	3,700	21.3	C
Exit 12	Exit 13	3,900	22.4	C	3,900	22.4	C	Exit 14	Exit 13	3,800	21.9	C	3,900	22.4	C
Exit 13	Exit 14	3,600	20.7	C	4,050	23.3	C	Exit 13	Exit 12	3,500	20.2	C	4,100	23.6	C
Exit 14	Exit 15	3,400	19.6	C	4,000	23.0	C	Exit 12	Exit 11	3,000	17.3	B	3,100	17.8	B
Exit 15	Exit 16	3,400	19.6	C	3,900	22.4	C	Exit 11	Exit 10	3,300	19.0	C	3,700	21.3	C

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).

2.6.2 Ramp Operations

The analysis of merge and diverge operations at ramps is based on procedures presented in Chapter 25, Ramps and Ramp Junctions, of the HCM. The procedures focus on the interaction between freeway mainline through traffic and traffic merging from or diverging to ramps. The analysis takes into account geometric and operational factors such as the length and taper of the acceleration/deceleration lanes, free-flow vehicle speed along the freeway and on the ramps themselves, and the number of vehicles in the right-most (or left-most for left exits) two lanes of the freeway. The focus of the analysis is at the ramp junction with the mainline where entering vehicles attempt to find gaps in the adjacent traffic stream. The action of this merging traffic creates vehicle turbulence along the mainline which can affect freeway operations. The converse of this action is the diverge movement which forces exiting vehicles to shift in advance and occupy the right travel lane in order to exit the freeway causing temporary instability as the vehicles shift lanes and decelerate. According to the HCM, the influence area for both of these movements is approximately 1,500 feet before the diverge areas and beyond the merge areas (including acceleration and deceleration lanes). Table 2-20 presents the LOS criteria.

Table 2-20 Ramp Level of Service Criteria

Level of Service	Ramp Density[1]
A	0 to 10
B	> 10 to 20
C	> 20 to 28
D	> 28 to 35
E	> 35
F	Demand exceeds capacity

Source: Transportation Research Board, Highway Capacity Manual (HCM 2000), (Washington, DC).
1 Density is expressed in passenger cars per mile per lane

The results of the merge and diverge analyses for I-95 are presented in Table 2-21 and Table 2-22, respectively. The results of the merge and diverge analyses for I-495 are presented in Table 2-23 and Table 2-24, respectively. The results are also presented graphically in the existing conditions figures for the I-95 and I-495 corridors (Figures 2-13-2-19). Capacity analysis worksheets for ramp merges and diverges are included in the Appendix. Key results of the merge analyses include:

I-95 Northbound - During the morning peak hour, eight of the 16 on-ramps to I-95 northbound operate under congested conditions (LOS E/F). Poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream and downstream off-ramps. The remaining eight I-95 northbound on-ramps operate at acceptable LOS D or better during the morning peak hour. All I-95 northbound on-ramps operate at LOS D or better during the evening peak hour, with the exception of the I-295 on-ramp (Exit 4) which operates at LOS E.

I-95 Southbound - All I-95 southbound on-ramps operate at LOS C or better during the morning peak hour. During the evening peak hour, eight of the 14 on-ramps to I-95 southbound operate under congested conditions (LOS E/F). Similar to the northbound direction during the morning peak hour, poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream and downstream off-ramps. The remaining six I-95 southbound on-ramps operate at acceptable LOS D or better during the evening peak hour.

I-495 Northbound - During both the morning and evening peak hours, all on-ramps to I-495 northbound within the study area operate at LOS D or better.

I-495 Southbound - During both the morning and evening peak hours, all on-ramps to I-495 southbound within the study area operate at LOS D or better.

The results of the diverge analyses include:

I-95 Northbound - During the morning peak hour, eight of the 13 off-ramps from I-95 northbound operate under congested conditions (LOS E/F). Poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream on-ramps (i.e. a weaving condition). The remaining five I-95 northbound on-ramps operate at acceptable LOS D or better during the morning peak hour. All I-95 northbound off-ramps operate at LOS D or better during the evening peak hour, with the exception of the I-295 off-ramp (Exit 4) which operates at LOS F.

I-95 Southbound - All I-95 southbound off-ramps operate at LOS D or better during the morning peak hour. During the evening peak hour, 12 of the 16 off-ramps from I-95 southbound operate under congested conditions (LOS E/F). Similar to the northbound direction during the morning peak hour, poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream on-ramps. The emaining four I-95 southbound off-ramps operate at acceptable LOS D or better during the evening peak hour.

I-495 Northbound - During both the morning and evening peak hours, all off-ramps from I-495 northbound within the study area operate at LOS D or better.

I-495 Southbound - During both the morning and evening peak hours, all off-ramps from I-495 southbound within the study area operate at LOS D or better. An exception to this occurs at the off-ramp from I-495 southbound to Route 1 northbound (Exit 14A) which operates at LOS E during the evening peak hour. Poor operations at this location are influenced by heavy mainline volumes and an adjacent upstream on-ramp which creates a weaving situation.

Table 2-21 I-95 Merge Ramp Capacity Analyses Summary — 2008 Existing Conditions

I-95 Northbound

Ramp Description	Weekday Morning Peak Hour Volume[1]	Density[2]	LOS[3]	Weekday Evening Peak Hour Volume	Density	LOS
Exit 1	300	25.4	C	200	23.1	C
Exit 2A	150	23.7	C	50	23.2	C
Exit 2B	700	27.1	C	550	22.4	C
Exit 3A	350	24.6	C	150	19.6	B
Exit 3B	500	27.6	C	300	21.2	C
Exit 4	1,650	43.0	F	1,550	38.4	E
Exit 5	900	37.2	E	400	26.2	C
Exit 6A	1,000	49.1	F	650	27.1	C
Exit 6B	1,100	38.0	E	400	22.6	C
Exit 7A	100	37.2	E	50	19.4	B
Exit 7B	850	40.2	F	500	21.9	C
Exit 8	650	35.1	E	250	19.3	B
Exit 9	700	31.8	D	500	20.5	C
Exit 10	400	32.8	D	350	21.4	C
Exit 11A	200	36.7	E	250	21.4	C
Exit 11B	300	30.2	D	150	21.1	C

I-95 Southbound

Ramp Description	Weekday Morning Peak Hour Volume	Density	LOS	Weekday Evening Peak Hour Volume	Density	LOS
Slip Ramp	100	19.0	B	900	36.7	E
Exit 11B	250	18.6	B	350	40.5	F
Exit 11A	200	18.0	B	350	39.0	F
Exit 9	550	20.0	B	1,200	37.7	E
Exit 8	450	19.0	B	400	32.2	D
Exit 7B	300	22.8	C	650	50.8	F
Exit 7A	350	21.1	C	400	38.9	E
Exit 6B	900	22.9	C	1,100	45.9	F
Exit 6A	750	25.0	C	1,000	36.9	E
Exit 5	600	24.3	C	650	32.3	D
Exit 4	400	19.8	B	450	24.5	C
Exit 3B	500	21.9	C	500	26.9	C
Exit 2B	350	22.4	C	450	31.3	D
Exit 2A	400	22.1	C	300	22.5	C

Source: VHB, Inc. using HCS2000 methodologies.
Noted: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 2-22 I-95 Diverge Ramp Capacity Analyses Summary — 2008 Existing Conditions

I-95 Northbound

Ramp Description	Weekday Morning Peak Hour Volume[1]	Density[2]	LOS[3]	Weekday Evening Peak Hour Volume	Density	LOS
Exit 2A	400	26.8	C	400	24.7	C
Exit 2B	250	25.4	C	450	20.2	C
Exit 3A	650	28.7	D	550	24.1	C
Exit 4	300	59.1	F	550	47.3	F
Exit 5	500	35.3	E	550	28.5	D
Exit 6A	1,050	38.0	E	950	28.9	D
Exit 6B	1,050	53.7	F	700	32.0	D
Exit 7A	700	35.9	E	350	23.1	C
Exit 7B	450	31.1	D	250	19.1	B
Exit 8	500	37.2	E	450	25.3	C
Exit 9	1,550	39.2	E	600	23.9	C
Exit 11A	600	35.1	E	300	24.3	C
Exit 11B	500	35.0	D	250	26.0	C

I-95 Southbound

Ramp Description	Weekday Morning Peak Hour Volume[1]	Density[2]	LOS[3]	Weekday Evening Peak Hour Volume	Density	LOS
Exit 11B	300	22.9	C	350	37.6	E
Exit 11A	150	23.9	C	350	48.6	F
Exit 10	400	21.7	C	600	36.4	E
Exit 9	400	20.2	C	800	35.1	E
Exit 8	250	19.4	B	700	35.3	E
Exit 7B	100	21.8	C	150	34.8	D
Exit 7A	450	25.8	C	850	56.0	F
Exit 6B	650	23.0	C	950	35.7	E
Exit 6A	400	29.6	D	900	53.1	F
Exit 5	500	27.0	C	900	37.8	E
Exit 4	1,300	28.6	D	2,300	39.6	F
Exit 3B	150	20.6	C	350	25.8	C
Exit 3A	300	29.1	D	400	35.8	F
Exit 2B	100	20.9	C	200	24.4	C
Exit 2A	350	28.7	D	700	35.3	E
Exit 1	100	22.6	C	200	23.6	C

Source: VHB, Inc. using HCS2000 methodologies.
Noted: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 2-23 I-495 Merge Ramp Capacity Analyses Summary — 2008 Existing Conditions

I-495 Northbound

Ramp Description	Weekday Morning Peak Hour Volume[1]	Density[2]	LOS[3]	Weekday Evening Peak Hour Volume	Density	LOS
Exit 11/12	900	26.7	C	700	26.1	C
Exit 13A	1,050	27.5	C	700	32.5	D
Exit 13B	650	23.1	C	1,100	28.3	D
Exit 14A	350	22.7	C	200	26.9	C
Exit 14B	200	22.7	C	450	25.5	C
Exit 15	400	25.2	C	450	26.9	C

I-495 Southbound

Ramp Description	Weekday Morning Peak Hour Volume	Density	LOS	Weekday Evening Peak Hour Volume	Density	LOS
Exit 15	350	22.7	C	650	23.9	C
Exit 14B	250	23.9	C	550	24.8	C
Exit 14A	350	23.2	C	250	23.4	C
Exit 13B	400	29.4	D	900	28.7	D
Exit 13A	1,050	22.8	C	950	25.6	C
Exit 11/12	300	17.7	B	600	20.6	C

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 2-24 I-495 Diverge Ramp Capacity Analyses Summary — 2008 Existing Conditions

I-495 Northbound

Ramp Description	Weekday Morning Peak Hour Volume[1]	Density[2]	LOS[3]	Weekday Evening Peak Hour Volume	Density	LOS
Exit 11/12	600	21.4	C	400	20.3	C
Exit 13A	1,100	28.3	D	400	26.8	C
Exit 13B	650	33.5	D	950	32.2	D
Exit 14A	550	25.4	C	300	26.1	C
Exit 14B	200	29.4	D	400	27.2	C
Exit 15	400	25.4	C	550	27.7	C

I-495 Southbound

Ramp Description	Weekday Morning Peak Hour Volume	Density	LOS	Weekday Evening Peak Hour Volume	Density	LOS
Exit 15	300	24.8	C	550	25.3	C
Exit 14B	150	23.9	C	350	24.5	C
Exit 14A	300	27.6	C	250	35.5	E
Exit 13B	750	25.2	C	1,000	26.2	C
Exit 13A	1,000	29.3	D	650	34.1	D
Exit 11/12	500	15.2	B	1,000	20.4	C

Source: VHB, Inc. using HCS2000 methodologies.
Noted: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst

2.6.3 Weaving Segment Operations

The analysis of weaving operations at interchange ramps is based on procedures presented in Chapter 24, Freeway Weaving, of the Highway Capacity Manual. A weaving movement is defined as the interaction between the crossings of two or more traffic streams traveling in the same direction without the aid of traffic control devices. The measure of effectiveness to determine the level of service is based on many parameters, including density and the speed of both the weaving and non-weaving vehicles. The higher the speeds and lower the density, the better the operations of the weaving segment. Similar to ramp merge and diverge areas, LOS D (as defined in the Highway Capacity Manual) is considered to be the acceptable limit and LOS E or F conditions are typically considered unacceptable.

Table 2-25 summarizes the LOS criteria for weaving segments.

Table 2-25 Weave Level of Service Criteria

Level of Service	Weave Density[1]
A	0 to 12
B	> 12 to 24
C	> 24 to 32
D	> 32 to 36
E	> 36 to 40
F	> 40

Source: Transportation Research Board, Highway Capacity Manual (HCM 2000), (Washington, DC).
1 Density is expressed in passenger cars per mile per lane

The results of the weaving segment analysis for I-95 and I-495 under morning and evening peak hour conditions are summarized in Table 2-26 and Table 2-27, respectively. The results are also presented graphically in the existing conditions Figures 2-13 through 2-19 for the I-95 and I-495 corridors. Capacity analysis worksheets for weaving segments are included in the Appendix. Key results include:

I-95 Northbound - During the morning peak hour, the following two of the five weaving segments operate under congested conditions (LOS E):

- I-95 northbound from I-295 on-ramp to I-295 off-ramp (Exit 4); and
- I-95 northbound from I-495 southbound on-ramp to I-495 northbound off-ramp (Exit 6).

The remaining three weaving segments along I-95 northbound operate at LOS D or better during the morning peak hour. During the evening peak hour, the weaving segments in the northbound direction are generally operating at acceptable levels within the study area. An exception to this occurs along I-95 northbound from I-295 on-ramp to I-295 off-ramp (Exit 4) which operates at LOS E.

I-95 Southbound - During the morning peak hour, all weaving segments of I-95 southbound within the study area operate at LOS C or better. During the evening peak hour, two of the five segments of I-95 southbound operate under congested conditions (LOS E):

- I-95 southbound from Route 140 northbound on-ramp to Route 140 southbound off-ramp (Exit 7); and
- I-95 southbound from I-495 northbound on-ramp to I-495 southbound off-ramp (Exit 6).

I-495 Northbound - During both the morning and evening peak hours, all weaving segments of I-495 northbound within the study area operate at LOS C or better.

I-495 Southbound -- During both the morning and evening peak hours, all weaving segments of I-495 southbound within the study area operate at LOS C or better.

Table 2-26 I-95 Weaving Segments Capacity Analyses Summary — 2008 Existing Conditions

Weave Segment Description	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
I-95 Northbound	Dem[1]	Density[2]	LOS[3]	Dem	Density	LOS
I-95 NB Exit 2	3,650	17.37	B	3,150	15.10	B
I-95 NB Exit 4	5,950	41.87	E	4,700	35.73	E
I-95 NB Exit 6	6,000	41.96	E	3,700	22.73	C
I-95 NB Exit 7	5,450	28.43	D	3,100	13.93	B
I-95 NB Exit 11	5,150	27.44	C	3,350	15.99	B
I-95 Southbound	Dem	Density	LOS	Dem	Density	LOS
I-95 SB Exit 11	3,000	13.84	B	6,100	33.85	D
I-95 SB Exit 7	3,200	16.15	B	6,100	38.93	E
I-95 SB Exit 6	3,350	20.80	C	5,800	40.83	E
I-95 SB Exit 3	3,250	16.45	B	3,950	20.83	C
I-95 SB Exit 2	3,200	16.13	B	3,800	21.89	C

Source: VHB, Inc. using HCS2000 methodologies.
Noted: Shaded cells denote LOS E or LOS F conditions.
1 Demand – Weave segments demand in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

Table 2-27 I-495 Weaving Segments Capacity Analyses Summary — 2008 Existing Conditions

I-495 Northbound						
	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Weave Segment Description	Dem[1]	Density[2]	LOS[3]	Dem	Density	LOS
I-495 NB Exits 11&12 C-D Roadway	1,450	19.3	B	950	10.7	A
I-495 NB Exit 13	3,850	28.1	D	4,200	28.7	D
I-495 NB Exit 14	3,400	16.0	B	3,950	19.1	B
I-495 Southbound						
	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Weave Segment Description	Dem	Density	LOS	Dem	Density	LOS
I-495 SB Exit 14	3,750	18.2	B	3,900	20.2	C
I-495 SB Exit 13	3,450	22.3	C	3,800	25.4	C
I-495 SB Exits 11&12 C-D Roadway	700	7.9	A	1,650	19.2	B

Source: VHB, Inc. using HCS2000 methodologies.

1 Demand – Weave segments demand in vehicles per hour.

2 Density – Expressed in passenger cars per mile per lane.

3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

2.6.4 Intersection Operations

Capacity analyses were conducted for the signalized and unsignalized intersections within the study area to assess the quality of traffic flow. These analyses provide an indication of how well the existing transportation infrastructure handles the existing traffic volumes and provides a basis for assessing operations with forecasted traffic demands. The capacity analyses were conducted using Synchro software (Version 7, Build 763), which is based on the 2000 Highway Capacity Manual.

Level-of-service for signalized intersections is based on average delay for all vehicles entering the intersection, including initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. For unsignalized intersections, level-of-service is based on stopped delay for vehicles on the side street approaches since the main street traffic is not affected by side street traffic. The level-of-service criteria for signalized intersections are presented in Table 2-28 and the criteria for unsignalized intersections are presented in Table 2-29.

Table 2-28 Level-of-Service Criteria for Signalized Intersections

Level of Service	Stopped Delay per Vehicle (seconds)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

Source: Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, DC (2000).

Table 2-29 Level-of-Service Criteria for Unsignalized Intersections

Level of Service	Stopped Delay per Vehicle (seconds)
A	≤10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	>50.0

Source: Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, DC (2000).

I-95/I-495 Intersection Operations

Capacity analyses were conducted at all intersections of ramp termini with local streets within the study area. In addition, capacity analyses were conducted at several predefined intersections within the study area that are adjacent to the I-95 and I-495 mainlines and are potentially impacted by traffic entering onto or exiting from I-95 and I-495.

The results of signalized and unsignalized intersection capacity analysis for I-95 and I-495 interchanges under morning and evening peak hour conditions are summarized in Table 2-30 and Table 2-31, respectively. These results are also presented graphically in the existing conditions figures for each of the individual interchanges along I-95 and for I-495 (Figures 2-20 through 2-31). Capacity analysis worksheets are included in the Appendix.

Key results at signalized intersections include:

I-95 - Seven of the eight signalized study area intersections operate at LOS D or better. During the evening peak hour, the intersection of Route 140 at Forbes Boulevard (Exit 7) operates at LOS F.

I-495 – Three of the four signalized study area intersections operate at LOS D or better. During the evening peak hour, the intersection of Route 140 at School Street (Exit 11/12) operates at LOS E.

Table 2-30 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions

		Weekday Morning Peak Hour				Weekday Evening Peak Hour			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]
Toner Blvd. at Burden Ave./North Ave.	EB LT-TH	0.43	17	B	234	0.40	23	C	189
(I-95 Exit 5)	EB RT	0.13	6	A	27	0.12	8	A	28
	WB LT	0.19	6	A	28	0.43	24	C	180
	WB TH-RT	0.21	5	A	56	0.44	25	C	302
	NB LT	0.61	36	D	137	0.69	37	D	187
	NB TH-RT	0.16	31	C	32	0.10	28	C	33
	SB LT-TH-RT	0.27	44	D	25	0.20	44	D	16
	Overall	*0.46*	*17*	*B*		*0.50*	*25*	*C*	
Toner Blvd. at Triboro Plaza driveway	EB LT	0.09	5	A	42	0.42	18	B	108
(I-95 Exit 5)	EB TH	0.30	7	A	288	0.19	3	A	51
	WB TH-RT	0.20	3	A	33	0.47	4	A	32
	SB LT	0.32	41	D	44	0.53	39	D	107
	SB RT	0.03	39	D	23	0.12	36	D	55
	Overall	*0.30*	*7*	*A*		*0.47*	*10*	*A*	
Toner Blvd. at John Dietsch Blvd.	EB LT	0.12	3	A	15	0.18	14	B	42
(I-95 Exit 5)	EB TH	0.34	6	A	286	0.25	13	B	187
	WB TH	0.20	5	A	50	0.55	12	B	158
	WB RT	0.20	2	A	3	0.24	8	A	m41
	SB LT	0.68	41	D	147	0.79	38	D	193
	SB RT	0.04	31	C	26	0.07	24	C	13
	Overall	*0.40*	*9*	*A*		*0.63*	*17*	*B*	
Toner Blvd. at I-95 SB Exit 5 Ramps	EB LT	0.36	3	A	26	0.47	6	A	m97
(I-95 Exit 5)	EB TH	0.29	2	A	36	0.24	4	A	111
	WB TH	0.23	7	A	92	0.37	12	B	210
	WB RT	0.28	8	A	30	0.21	11	B	49
	SB LT	0.53	39	D	88	0.51	33	C	108
	SB RT	0.14	36	D	61	0.61	37	D	148
	Overall	*0.38*	*11*	*B*		*0.48*	*17*	*B*	
Toner Blvd. at Route 152	EB LT	0.69	37	D	191	1.06	94	F	#468
(I-95 Exit 5)	EB RT	0.34	30	C	57	0.67	36	D	#247
	NB LT	0.79	15	B	299	0.85	21	C	339
	NB TH	0.18	5	A	68	0.17	6	A	64
	SB TH	0.20	22	C	85	0.45	27	C	165
	SB RT	0.21	23	C	65	0.24	25	C	62
	Overall	*0.77*	*22*	*C*		*0.91*	*36*	*D*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 2-30 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions (cont.)

		Weekday Morning Peak Hour				Weekday Evening Peak Hour			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]
Route 140 at Fisher Street	EB LT-RT	0.49	42	D	120	0.60	48	D	#129
(I-95 Exit 7)	NB LT	0.07	4	A	m2	0.22	6	A	m5
	NB TH	0.61	9	A	m132	0.60	6	A	m134
	SB TH-RT	0.49	8	A	252	0.53	8	A	248
	Overall	*0.59*	*10*	*A*		*0.60*	*8*	*A*	
Route 140 at Forbes Blvd.	EB LT	>1.20	>120	F	#325	>1.20	>120	F	#490
(I-95 Exit 7)	EB LT-TH	>1.20	>120	F	#334	>1.20	>120	F	#501
	EB RT	0.00	40	D	13	0.01	28	C	16
	WB LT	0.23	41	D	#40	1.07	>120	F	#106
	WB TH	0.40	42	D	#131	1.03	>120	F	#147
	WB RT	0.59	46	D	#217	>1.20	>120	F	#233
	NB LT	0.04	15	B	10	0.12	24	C	12
	NB TH	0.47	21	C	192	0.56	31	C	215
	NB RT	0.03	16	B	18	0.04	24	C	24
	SB LT	0.50	14	B	124	0.60	25	C	171
	SB TH	0.32	11	B	92	0.82	26	C	#508
	SB RT	0.29	10	A	20	0.22	20	B	71
	Overall	*0.62*	*49*	*D*		*1.11*	*>120*	*F*	
Mechanic Street at Oak Street	EB LT-TH-RT	0.64	8	A	146	0.73	19	B	137
(I-95 Exit 8)	WB LT	n/a	n/a	n/a	n/a	1.19	112	F	#269
	WB TH-RT	n/a	n/a	n/a	n/a	0.57	5	A	93
	WB LT-TH-RT[5]	0.35	6	A	34	n/a	n/a	n/a	n/a
	NB LT	0.13	12	B	25	0.72	41	D	#80
	NB TH-RT	0.23	12	B	2	0.14	23	C	0
	Overall	*0.53*	*9*	*A*		*1.07*	*46*	*D*	
Neponset Street at Wedgewood Drive	EB LT-TH-RT	0.57	47	D	86	0.51	44	D	69
(I-95 Exit 11)	WB LT-TH-RT	0.27	49	D	10	0.48	55	D	12
	NB LT-TH-RT	0.94	25	C	#1184	0.80	13	B	#904
	SB LT-TH-RT	0.59	8	A	425	1.00	36	D	#1187
	Overall	*0.88*	*20*	*B*		*0.93*	*27*	*C*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 2-30 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions (cont.)

		Weekday Morning Peak Hour				Weekday Evening Peak Hour			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]
Route 140 at School Street	EB LT	0.42	44	D	69	0.66	48	D	110
(I-495 Exit 11/12)	EB TH	0.68	46	D	184	1.06	112	F	#396
	EB RT	0.05	35	D	38	0.13	36	D	61
	WB LT	0.76	44	D	#261	0.64	42	D	156
	WB TH	0.17	31	C	60	0.69	42	D	161
	WB RT	0.04	30	C	30	0.04	34	C	27
	NB LT	1.20	>120	F	#132	>1.20	>120	F	#231
	NB TH	0.63	27	C	278	0.35	26	C	161
	NB RT	0.19	21	C	52	0.12	23	C	51
	SB LT	0.19	25	C	31	0.55	22	C	157
	SB TH	0.26	29	C	92	0.94	53	D	#421
	SB RT	0.04	26	C	28	0.39	32	C	139
	Overall	*0.77*	*42*	*D*		*>1.20*	*77*	*E*	
Route 1A at Premium	EB LT	0.52	35	D	58	0.96	53	D	#363
Outlet Blvd. (I-495 Exit 15)	EB LT-TH	0.54	36	D	60	0.96	55	E	#365
	EB RT	0.02	32	C	21	0.13	16	B	31
	WB LT-TH	0.53	34	C	36	0.45	35	D	41
	WB RT	0.05	29	C	23	0.07	33	C	37
	NB LT	0.15	10	A	47	0.53	23	C	71
	NB TH-RT	0.42	16	B	182	0.43	27	C	108
	SB LT	0.13	6	A	17	0.17	18	B	m19
	SB TH	0.18	9	A	71	0.84	31	C	#213
	SB RT	0.11	14	B	52	0.31	32	C	m66
	Overall	*0.39*	*17*	*B*		*0.84*	*37*	*D*	
Route 1A at I-495 SB Exit 15 off-ramp (I-495 Exit 15)	EB LT	0.51	34	C	76	0.57	34	C	#103
	EB RT	0.09	30	C	41	0.28	30	C	59
	NB LT	0.24	8	A	123	0.80	15	B	m140
	NB TH	0.24	7	A	165	0.28	2	A	m10
	SB TH	0.20	4	A	25	0.49	10	B	181
	SB RT	0.14	0	A	0	0.10	9	A	39
	Overall	*0.28*	*9*	*A*		*0.74*	*13*	*B*	
Route 1A at I-495 NB Exit 15 off-ramp (I-495 Exit 15)	WB LT	0.12	6	A	30	0.21	8	A	79
	WB RT	0.10	6	A	11	0.15	8	A	34
	NB TH	0.39	26	C	108	0.42	14	B	59
	NB RT	0.25	88	F	160	0.27	16	B	16
	SB LT-TH	0.66	32	C	117	0.72	29	C	154
	Overall	*0.27*	*38*	*D*		*0.38*	*17*	*B*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
5 Mechanic Street westbound approach operates as a defacto left-turn lane and a shared through/right-turn lane during the evening peak hour; analysis adjusted to reflect operating conditions.
95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
n/a not applicable
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Key results at unsignalized intersections include:

I-95 Exit 1 – During the evening peak hour, the eastbound and westbound approaches to the Route 1 at Scott Street intersection currently operate at LOS F and LOS E, respectively.

I-95 Exit 2 – During the morning peak hour, the westbound approach of the intersection of Route 1A at MBTA Commuter Rail Station/Bristol Place operates at LOS F. Three out of four minor street approaches of intersections at the I-95 off-ramps with Route 1A currently operate at LOS F during the evening peak hour, with the exception of the intersection of Route 1 A at I-95 SB Exit 2B off-ramp. Additionally, the eastbound and westbound minor street approaches of Route 1A at MBTA Commuter Rail Station/Bristol Place operate at LOS F during the evening peak hour.

I-95 Exit 3 – During the morning peak hour, the southbound approach of the intersection of Route 123 at Lathrop Drive operates at LOS F. At the intersection of Route 123 at I-95 NB Exit 3A off-ramps, the northbound left-turn and right-turn movements operate at LOS F during the evening peak hour. Additionally, the southbound approach of the intersection of Route 123 at Lathrop Drive operates at LOS F during the evening peak hour.

I-95 Exit 5 –The southbound left-turn of the intersection of Toner Boulevard at I-95 NB ramps operates at LOS F during both peak hours.

I-95 Exit 7 – The minor street approaches of the intersections of Route 140 at Walnut Street and Route 140 at I-95 NB Exit 7A off-ramp operate at LOS F during both peak hours. Additionally, the minor street approach of the intersection of Route 140 at I-95 SB Exit 7A off-ramp operates at LOS F during the evening peak hour.

I-95 Exit 8 –The minor street approach of the intersection of South Main Street at I-95 SB Exit 8 off-ramp operates at LOS F during the evening peak hour.

I-95 Exit 10 – During the morning peak hour, the eastbound approach of the intersection of Coney Street at Rustic Road operates at LOS E. The minor street approaches of the intersections of Coney Street at I-95 SB Exit 10 off-ramp and Coney Street at Rustic Road all operate at LOS F during the evening peak hour.

I-95 Exit 11 – During the morning peak hour, the minor street approaches of the intersections of Neponset Street at I-95 NB Exit 11A and Exit 11B off-ramps operate at LOS E during the morning peak hour.

I-495 Exit 11/12 – During the evening peak hour, the eastbound approach of the intersection of Route 140 at I-495/C-D Roadway SB off-ramp operates at LOS F.

Table 2-31 Unsignalized Intersection Capacity Analysis Summary — 2008 Existing Conditions

Intersection	Critical Movement(s)	Weekday Morning Peak Hour					Weekday Evening Peak Hour				
		Dem[1]	v/c[2]	Del[3]	LOS[4]	Q[5]	Dem	v/c	Del	LOS	Q[5]
I-95 Exit 1											
Route 1 at I-95 SB Exit 1 off-ramp	SE RT	100	0.15	11	B	13	200	0.35	14	B	38
Route 1 at Scott Street	EB LT-TH-RT	5	0.08	22	C	6	neg	0.15	57	F	12
	WB LT-TH-RT	45	0.13	15	B	11	130	0.64	47	E	95
I-95 Exit 2											
Route 1A at I-95 SB Exit 2B off-ramp	NW RT	100	0.16	12	B	15	200	0.48	20	C	64
Route 1A at I-95 SB Exit 2A off-ramp	SE RT	350	0.58	18	C	93	700	1.18	118	F	639
Route 1A at I-95 NB Exit 2B off-ramp	NW RT	250	0.45	16	C	57	450	1.08	96	F	400
Route 1A at I-95 NB Exit 2A off-ramp	SE RT	400	0.78	30	D	179	400	1.15	>120	F	417
Route 1A at MBTA Commuter Rail Station/Bristol Place	EB RT	90	0.36	19	C	41	335	>1.20	>120	F	572
	WB RT	170	0.80	48	E	169	455	>1.20	>120	F	862
I-95 Exit 3											
Route 123 at I-95 NB Exit 3A off-ramp	NB LT	45	0.23	25	C	21	50	0.46	56	F	51
Route 123 at I-95 SB Exit 3A off-ramp	NB RT	470	0.84	32	D	229	505	1.04	77	F	407
Route 123 at Lathrop Drive	SB LT-RT	210	>1.20	>120	F	389	390	>1.20	>120	F	858
I-95 Exit 5											
Toner Blvd. at I-95 NB Ramps	SB LT	220	>1.20	Err	F	Err	370	>1.20	Err	F	Err
I-95 Exit 7											
Route 140 at Walnut Street	EB LT-TH-RT	130	0.82	77	F	144	65	0.71	83	F	99
	WB LT-TH-RT	25	>1.20	>120	F	130	50	>1.20	>120	F	208
Route 140 at I-95 SB Exit 7B off-ramp	NW RT	110	0.21	13	B	20	150	0.26	13	B	25
Route 140 at I-95 SB Exit 7A off-ramp	SE RT	460	0.66	18	C	124	880	>1.20	>120	F	1081
Route 140 at I-95 NB Exit 7B off-ramp	NW RT	490	0.81	30	D	211	250	0.60	25	C	98
Route 140 at I-95 NB Exit 7A off-ramp	SE RT	715	>1.20	>120	F	870	360	1.09	109	F	359
I-95 Exit 8											
S. Main St. at I-95 NB Exit 8 off-ramp	NB LT	40	0.71	23	C	153	50	0.70	26	D	145
S. Main St. at I-95 SB Exit 8 off-ramp	SB LT	35	0.21	14	B	20	120	1.09	78	F	534
I-95 Exit 10											
Coney Street at I-95 SB Exit 10 off-ramp	WB LT	115	0.63	23	C	114	260	>1.20	>120	F	715
Coney Street at Rustic Road	EB LT-TH-RT	20	0.26	46	E	24	120	0.57	63	F	71
	WB LT-TH-RT	30	0.23	28	D	21	55	0.75	89	F	108
I-95 Exit 11											
Neponset Street at I-95 SB Exit 11B off-ramp	SW RT	300	0.63	23	C	109	350	0.61	19	C	103
Neponset Street at I-95 SB Exit 11A off-ramp	NE RT	150	0.23	12	B	23	350	0.66	23	C	123
Neponset Street at I-95 NB Exit 11B off-ramp	SW RT	500	0.86	36	E	244	250	0.47	17	C	63
Neponset Street at I-95 NB Exit 11A off-ramp	NE RT	660	0.92	38	E	319	300	0.67	26	D	122
I-495 Exit 11/12											
Route 140 at I-495/C-D Roadway SB off-ramp	EB LT	25	0.48	13	B	65	85	1.06	68	F	531
Route 140 at Comcast Center main driveway	EB LT	5	0.03	21	C	2	15	0.05	25	C	4
	EB RT	5	0.02	10	B	1	neg	0.00	11	B	0

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 Dem – Demand.
2 V/C – Volume-to-capacity ratio. Values over 1.0 indicate demand in excess of capacity.
3 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
4 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
n/a not applicable
Neg Negligible
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn

I-95 Exit 9 – Route 1 Operations

The locations where I-95 Exit 9 ramp termini intersect with Route 1 present special analyses conditions. These locations are a series ramp merges and diverges and there are weaving segments along Route 1 northbound and southbound. Ramp merge, diverge and weaving segment capacity analyses for the morning and evening peak hour conditions are summarized in Table 2-32, Table 2-33, and Table 2-34 respectively. These results are also presented graphically in the existing conditions figure for the Route 1 and I-95 Exit 9 interchange (Figures 2-32 through 2-51). Capacity analysis worksheets are included in the Appendix. Key results include:

Route 1 Northbound – The weaving segment from I-95 NB off-ramp to I-95 NB on-ramp operates at LOS E during the morning peak hour.

Route 1 Southbound – The weaving segment from I-95 SB off-ramp to I-95 SB on-ramp operates at LOS F during the evening peak hour.

Table 2-32 I-95 Exit 9 – Route 1 Merge Ramp Capacity Analyses Summary — 2008 Existing Conditions

Location	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS
Route 1 SB U-turn merge with Route 1 NB	40	13.4	B	50	14.6	B
I-95 NB off-ramp merge with Route 1 NB	1,550	25.8	C	600	19.2	B
I-95 SB off-ramp merge with Route 1 SB	400	15.2	B	800	26.1	C

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 2-33 I-95 Exit 9 – Route 1 Diverge Ramp Capacity Analyses Summary — 2008 Existing Conditions

Location	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS
I-95 NB on-ramp diverge from Route 1 NB	700	27.4	C	500	19.5	B
I-95 SB on-ramp diverge from Route 1 SB	550	14.6	B	1,200	26.8	C
Route 1 SB U-turn diverge from Route 1 SB	40	9.8	A	50	15.8	B

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 2-34 I-95 Exit 9 – Route 1 Weaving Segment Capacity Analyses Summary — 2008 Existing Conditions

	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
Weave Segment Description	Dem[1]	Density[2]	LOS[3]	Dem	Density	LOS
Route 1 NB: I-95 NB off-ramp to I-95 NB on-ramp	2,505	41.2	E	1,685	23.2	C
Route 1 SB: I-95 SB off-ramp to I-95 SB on-ramp	1,365	21.4	C	2,640	50.6	F

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Demand – Weave segments demand in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

Route 1 Intersection Operations

Capacity analyses were also conducted at Route 1 study area intersections. The results of signalized and unsignalized intersection capacity analysis for Route 1 under morning and evening peak hour conditions are summarized in Table 2-35 and Table 2-36, respectively. These results are also presented graphically in the existing conditions figures for the Route 1 study area intersections. More detailed results, by lane group, are presented in the Appendix. Capacity analysis worksheets are also included in the Appendix.

Under the existing condition, 21 of the 35 signalized intersections along Route 1 operate at acceptable LOS D or better during both peak hours. The remaining 14 Route 1 signalized intersections operate at LOS E/F during one or both of the peak hours.

The minor street approaches at all four Route 1 unsignalized intersections operate at LOS E/F during at least one peak hour.

Table 2-35 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions

		2008 Existing Conditions		
Intersection	Time Period	V/C[1]	Delay[2]	LOS[3]
#79 Bridge Street (Route 109) at Boston Providence Highway (Route 1) - Boston	Weekday Morning	>1.20	>120	F
	Weekday Evening	>1.20	>120	F
#80 Washington Street at Route 1 (northern intersection) - Dedham	Weekday Morning	0.68	18	B
	Weekday Evening	0.72	21	C
#80 Washington Street at Route 1 (southern intersection) - Dedham	Weekday Morning	0.75	24	C
	Weekday Evening	0.75	34	C
#81 Eastern Avenue at Route 1 – Dedham	Weekday Morning	0.93	>120	F
	Weekday Evening	1.16	>120	F
#82 Elm Street at Route 1 - Dedham	Weekday Morning	>1.20	>120	F
	Weekday Evening	>1.20	>120	F
#83 Everett Street at Route 1 - Norwood	Weekday Morning	>1.20	>120	F
	Weekday Evening	>1.20	>120	F
#85 Dean Street at Route 1 - Norwood	Weekday Morning	>1.20	>120	F
	Weekday Evening	>1.20	>120	F
#86 Morse Street at Route 1 - Norwood	Weekday Morning	0.85	39	D
	Weekday Evening	0.97	61	E
#87 Sumner Street at Route 1 - Norwood	Weekday Morning	0.80	23	C
	Weekday Evening	0.79	23	C
#88 Union Street at Route 1 - Norwood	Weekday Morning	1.05	55	E
	Weekday Evening	1.20	80	E
#89 Coney Street at Route 1 - Walpole	Weekday Morning	0.81	33	C
	Weekday Evening	0.96	50	D
#90 Route 27 at Route 1 - Walpole	Weekday Morning	>1.20	>120	F
	Weekday Evening	>1.20	>120	F
#91 Old Post Road at Route 1 - Sharon	Weekday Morning	1.00	51	D
	Weekday Evening	1.19	68	E
#92 Pine Street at Route 1 - Walpole	Weekday Morning	0.88	23	C
	Weekday Evening	0.95	31	C
#93 Water Street at Route 1 - Foxborough	Weekday Morning	1.04	43	D
	Weekday Evening	>1.20	99	F
#94 Patriot Place at Route 1 - Foxborough	Weekday Morning	0.28	4	A
	Weekday Evening	0.67	8	A
#95 Pine Street at Route 1 - Foxborough	Weekday Morning	0.67	15	B
	Weekday Evening	0.74	20	B

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.

Table 2-35 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions (Continued)

Intersection	Time Period	2008 Existing Conditions V/C[1]	Delay[2]	LOS[3]
#97 Thurston Street at Route 1 - Wrenthem	Weekday Morning	0.74	10	A
	Weekday Evening	0.50	6	A
#99 Taunton Street at Route 1 (Washington Street) - Plainville	Weekday Morning	0.59	15	B
	Weekday Evening	0.56	18	B
#100 Route 106 at Route 1 - Plainville	Weekday Morning	0.65	22	C
	Weekday Evening	0.75	24	C
#101 Elmwood Street at Route 1 – N. Attlebo.	Weekday Morning	0.94	46	D
	Weekday Evening	>1.20	57	E
#102 Fisher Street at Route 1 – N. Attlebo.	Weekday Morning	0.39	6	A
	Weekday Evening	0.47	6	A
#103 Orne Street at Route 1 – N. Attlebo.	Weekday Morning	0.65	14	B
	Weekday Evening	0.60	12	B
#104 Elm Street at Route 1 – N. Attlebo.	Weekday Morning	0.72	17	B
	Weekday Evening	1.01	61	E
#105 Chestnut Street at Route 1 – N. Attlebo.	Weekday Morning	0.34	12	B
	Weekday Evening	0.74	18	B
#106 Draper Avenue at Route 1 – N. Attlebo.	Weekday Morning	0.49	17	B
	Weekday Evening	0.65	21	C
#107 Allen Avenue at Route 1 – N. Attlebo.	Weekday Morning	0.35	12	B
	Weekday Evening	0.81	38	D
#108 Cumberland Avenue at Route 1 - N. Attlebo.	Weekday Morning	0.34	9	A
	Weekday Evening	0.70	16	B
#109 May Street at Route 1 - Attleboro	Weekday Morning	0.44	16	B
	Weekday Evening	0.66	20	C
#110 Route 1A /driveway at Route 1 - Attleboro	Weekday Morning	0.50	12	B
	Weekday Evening	0.66	27	C
#111 Route 123 at Route 1 - Attleboro	Weekday Morning	0.70	51	D
	Weekday Evening	1.16	>120	F
#112 Brown Street at Route 1 - Attleboro	Weekday Morning	0.36	9	A
	Weekday Evening	0.56	11	B

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.

Table 2-35 Signalized Intersection Capacity Analysis Summary — 2008 Existing Conditions (cont.)

Intersection	Time Period	2008 Existing Conditions V/C[1]	Delay[2]	LOS[3]
#113 Mendon Road at Route 1 – Attleboro	Weekday Morning	0.30	7	A
	Weekday Evening	0.38	6	A
#114 Bacon Street at Route 1 – Attleboro	Weekday Morning	0.62	20	C
	Weekday Evening	0.86	26	C
#116 Hoppin Hill Avenue at Route 1	Weekday Morning	0.75	66	E
N. Attleboro	Weekday Evening	0.91	52	D

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.

Table 2-36 Unsignalized Intersection Capacity Analysis Summary — 2008 Existing Conditions

Intersection	Critical Movement(s)	Weekday Morning Peak Hour v/c[1]	Del[2]	LOS[3]	Q[4]	Weekday Evening Peak Hour v/c	Del	LOS	Q
#85 Dean Street at Route 1 SB off-ramp – Norwood	NB LT-TH-RT	0.25	26	D	24	0.68	65	F	98
	SB LT	1.05	>120	F	212	>1.20	>120	F	364
#85 Dean Street at Route 1 NB off-ramp	NB LT-RT	0.85	53	F	196	1.17	>120	F	462
#96 East Street at Route 1 - Foxborough	EB RT	0.09	10	B	7	0.36	23	C	40
	WB RT	0.77	46	E	152	0.24	11	B	23
#98 Madison Street at Route 1 - Wrenthem	EB LT-TH-RT	0.25	20	C	24	0.61	58	F	82
	WB LT-TH-RT	>1.20	>120	F	131	>1.20	>120	F	181

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn

2.7 Intelligent Transportation Systems (ITS)

The following is a summary of the existing Intelligent Transportation Infrastructure along the I-95 corridor in southern Massachusetts from the Route 128/I-95 circumferential highway to the Rhode Island border. This summary includes the Route 1 corridor, portions of Route 495 and portions of Route 128/I-95 around the I-95 interchange. The existing ITS devices and infrastructure are shown on the attached Figure 2-53.

2.7.1 ITS Devices

The following sections summarize the existing ITS devices along the I-95/Route 128, I-495, and Route 1 corridor.

I-95

Currently, there are several portable variable message signs (PVMS) permanently installed along the corridor at the following locations:

- I-95 southbound north of Exit 9 in Sharon
- I-95 southbound north of exit 5 in North Attleboro
- I-95 northbound ½ mile before exit 3 in Attleboro
- I-95 northbound north of Exit 9 in Sharon

The Rhode Island Department of Transportation also has existing Closed Circuit Television Camera (CCTV) coverage along I-95 just south of the Massachusetts border. They also have Dynamic Message Signs (DMS) along the I-95 corridor at the Massachusetts border. These devices are controlled from the Rhode Island Traffic Management Center in Providence, Rhode Island.

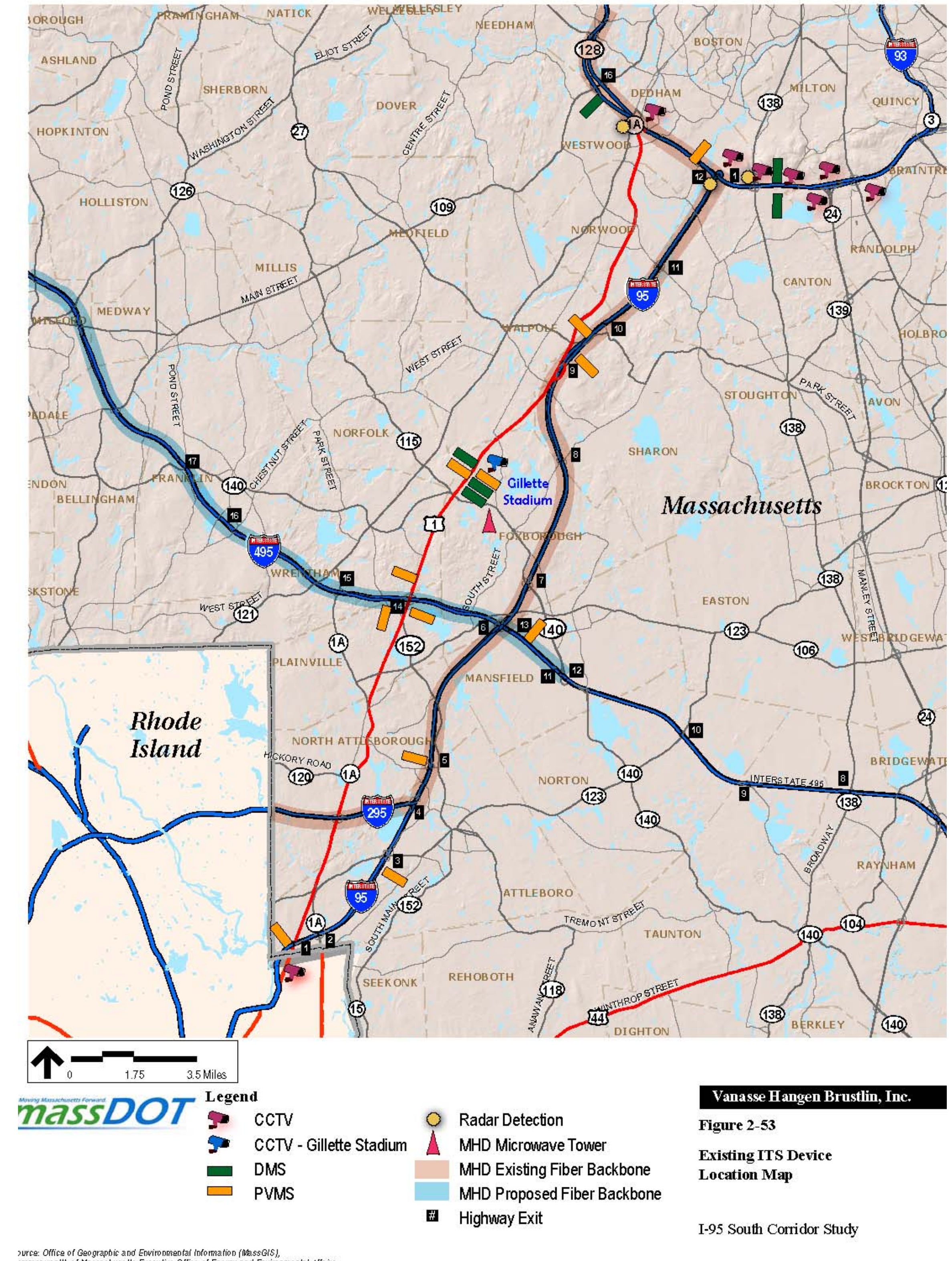

Figure 2-53

Existing ITS Device Location Map

Route 128

MassDOT has installed ITS devices along the Route 128 corridor as part of the I-95/Route 128 Advanced Transportation Management System Project (STP-000S(151). The following devices are installed on the I-95/Route 128 mainline in the vicinity of the interchange with I-95:

- Dynamic Message Signs (DMS):
  - Overhead DMS Northbound at Ponkapoag SB on-ramp in Milton
  - Overhead DMS Southbound at Ponkapoag SB on-ramp in Milton
  - Overhead DMS Southbound at Route 109 Southbound in Dedham
- Portable Variable Message Signs (PVMS):
  - Route 128/I-95 Northbound at exit 13 – University Ave.
- Closed Circuit Television Cameras (CCTV):
  - CCTV at Route 1 overpass in Dedham
  - CCTV at I-95 overpass in Milton
  - CCTV at Route 138 overpass in Canton
  - CCTV at Ponkapoag Trail on-ramp northbound
  - Two CCTV at junction with Route 24
- The following loop detectors systems are connected to the MassDOT Highway Operations Center and are unique from permanent count stations:
  - Loops northbound and southbound near Green Lodge Road
  - Loops northbound and southbound north of University Ave.
  - Loops northbound and southbound between Route 138 and Ponkapoag Trail Road
- Radar Detector Systems:
  - Radar detection for the mainline installed north of the interchange with I-95
  - Radar detection for the mainline at Route 138 interchange

I-495

The existing ITS devices on the Route 495 corridor include Portable Variable Message Signs that are permanently mounted at the following locations:

- I-495 northbound ½ mile before I-95
- I-495 southbound ½ mile before Route 1.

Route 1

The ITS devices that are currently implemented along this corridor include PVMS along the corridor at the following locations:

- Route 1 southbound before the I-495 overpass
- Route 1 northbound before the I-495 overpass

There are also devices located on the Route 1 corridor that are associated with events at Gillette Stadium. Gillette Stadium, home of the New England Patriots, is located along the southern portion of the Route 1 corridor in Foxboro and is located north of I-495. As part of the traffic management operations of the stadium, there are several Dynamic Message Signs (DMS) around the stadium. The DMS are both permanently mounted overhead signs and portable DMS. These signs are controlled by the Massachusetts DOT from the Traffic Operations Center (TOC) in Boston. The locations of these permanently mounted overhead DMS for Gillette Stadium are as follows:

- Two on Route 1 northbound immediately prior to Gillette Stadium
- One on Route 1 southbound immediately prior to Gillette Stadium

Gillette Stadium has also installed CCTV around the stadium for both monitoring of the traffic operations during events and also for security purposes. The Massachusetts State Police assist with the monitoring of those cameras, but MassDOT does not have control or viewing capability of these CCTV.

2.7.2 Communications Infrastructure

Fiber

There is an existing fiber optic communications backbone along I-95 from the Route 128/I-95 circumferential highway in Canton to the interchange with I-295, where the fiber backbone exits I-95 and continues along I-295 to the Rhode Island border. The conduit was installed by Level 3 Communications, LLC in July 2000. Out of the 42 total conduits along this route, MassDOT owns two 1-1/4" PVC Conduit. One of the conduits houses a 24 strand single mode fiber cable and one conduit is vacant.

There is also fiber planned for the I-495 corridor from Route 20 in Marlborough to just south of the I-95 interchange in Mansfield by the Commonwealth. This backbone has not been installed to date. Award of a design contract to complete this design is pending available funding.

Microwave

The Massachusetts DOT also has an existing state-wide microwave communications system. There are at least fifteen towers across the state for transmission of data to the MassDOT Traffic Operations Center in Boston. There is one tower within our study area located in Foxborough. This microwave assembly is capable of interfacing with a fiber optic backbone for transmission of any ITS device information along Route 1 or I-95. A fiber optic connection to the tower itself would be required as well as a full bandwidth analysis to determine the usable capacity of this communications alternative. The microwave link could also be used to provide redundancy of the fiber optic network backbone within this region.

2.7.3 511 Massachusetts

MassDOT 511 is a travel information service that provides personalized, real-time travel information to commuters in the Commonwealth. The service includes all major routes in Massachusetts, including I-95, I-495, and Route 1 from Route 128/I-95 to I-495 in the study area. Drivers are able to define their desired travel alerts and automatically receive personalized travel information alerts via email, text or telephone. Additionally, feeds from traffic cameras are available to view online for real-time travel conditions. The only traffic camera within the study area is at the interchange of I-95 at Route 128/I-93.

2.8 Transportation Infrastructure Review

Following a detailed traffic volume and operational review of the corridor, this section offers a detailed evaluation of each of the various interchanges and mainline components of the I-95 and I-495 study corridors and highlights both current design standards as well as locations where the design standards are currently either deficient or need additional evaluation.

This information is intended to both identify current roadway design issues and will ultimately be helpful in determining which roadway segments and intersections should be more closely examined as part of the development of future recommendations for the corridor.

2.8.1 Roadway Geometry

Methodology

Construction plans for the I-95 corridor from the Rhode Island state line to the I-93/Route 128 interchange in Canton and the I-495 corridor from West Street (Route 121) in Wrentham to South Main Street (Route 140) in Wrentham were obtained from the Massachusetts DOT. A comprehensive review of these plans was conducted to identify design elements that do not comply with current design standards. Where insufficient information was available on the plans, field visits and inspections were conducted to verify if the current conditions were satisfactory. Tables 2-37and 2-38 list the mainline and interchange design criteria, respectively, as presented in the *MassDOT Project Development & Design Guide*, January 2006. Geometric review of local roads was limited to ramp terminal geometry and access control.

Table 2-37 Mainline Design Criteria

Design Element	Criteria[1]	Reference[2]
Decision Sight Distance[3]	1,275 ft	Figure 3-9 (p. 3-40)
Stopping Sight Distance	730 ft	Figure 3-8 (p. 3-38)
Maximum Grade	3%	Figure 4-21 (p. 4-35)
Maximum Superelevation	6%	p. 4-17
Minimum Curve Radius (e=6%)	2,040 ft	Figure 4-8 (p. 4-17)
Rate of Vertical Curvature	Crest K_a=247 Sag K_a=181	Figure 4-26 (p. 4-42) Figure 4-27 (p. 4-44)
Minimum Distance between PVIs	1,500 ft	p. 4-45
Vertical Clearance	16.5 ft	Figure 4-28 (p. 4-44)
Lane Width	12 ft	Figure 5-14 (p. 5-31)
Left Shoulder	12 ft, 2 ft additional offset to barrier	p. 5-33
Right Shoulder	12 ft	p. 5-33

Source: MassHighway Project Development & Design Guide, January 2006. Compiled by VHB.
1 Design criteria assume 70 mph mainline design speed, single-lane ramps, and flat grade.
2 Figure and page numbers refer to the MassHighway Project Development & Design Guide, January 2006
3 Avoidance Maneuver D: Speed/path/direction change on suburban road

Table 2-38 Service Interchange Design Criteria

Design Element	Criteria[1]	Reference[2]
Deceleration Length	490 ft	Figure 7-13 & 7-15 (pp. 7-32 & 7-36)
Acceleration Length	1,230 ft	Figure 7-14 & 7-15 (pp. 7-35 & 7-36)
Distance between ramp terminals	500-2,000 ft	Figure 7-12 (p. 7-30)
Minimum Ramp Design Speed	35 mph	Figure 7-21 (p. 7-45)
Ramp Width	22 ft	p. 7-46
Ramp Cross-Slope	2%-6%	p. 7-46
Ramp Grade	0.5% - 6.0%	p. 7-51
Vertical Curvature	Crest K_a=29 Sag K_a=49	Figure 4-26 (p. 4-42) Figure 4-27 (p. 4-44)
Access Control	No access points within 500 ft of ramp terminal intersections	p. 7-31
	Four-lane roadways should be divided through interchange areas	p. 7-53

Source: MassHighway Project Development & Design Guide, January 2006. Compiled by VHB.
1 Design criteria assume 70 mph mainline design speed, single-lane ramps, and flat grade.
2 Figure and page numbers refer to the January, 2006 MassHighway Project Development & Design Guide

Table 2-39 System[3] Interchange Design Criteria

Design Element	Criteria[1]	Reference[2]
Distance between ramp terminals	500-2,000 ft	Figure 7-12 (p. 7-30)
Minimum Ramp Design Speed	70 mph	Figure 7-21 (p. 7-45)
Ramp Width	22 ft (single) 30 ft (double)	p. 7-46
Ramp Cross-Slope	2%-6% (superelevation)	p. 7-46
Ramp Grade	0.5% - 6.0%	p. 7-51
Minimum Horizontal Curve Radius	2,040 ft (e 6% superelevation)	Figure 4-8 (p.4-17)
Vertical Curvature	Crest K_a=247 Sag K_a=181	Figure 4-26 (p. 4-42) Figure 4-27 (p. 4-44)
Access Control	No access points within 500 ft of ramp terminal intersections	p. 7-31
	Four-lane roadways should be divided through interchange areas	p. 7-53

Source: MassHighway Project Development & Design Guide, January 2006. Compiled by VHB.
1 Design criteria assume 70 mph mainline design speed, single-lane ramps, and flat grade.
2 Figure and page numbers refer to the January, 2006 MassHighway Project Development & Design Guide
3 System Interchanges connect freeways to freeways

Mainline Deficiencies

Based on review of construction plans for the I-95 and I-495 corridors, the following geometric deficiencies were identified along the mainline:

- Left and right shoulder widths are inadequate. A 4 ft left shoulder and 10 ft right shoulder are provided along I-95 and I-495 throughout the study area. MassDOT design standards require 12 ft left and right shoulders along six-lane freeways with more than 250 trucks per hour.
- A minimum 30 ft clear zone should be provided at the right side of the freeway. During field visits, vegetation was observed to be encroaching on the clear zone along much of the corridor; however, MassDOT crews were observed removing vegetation from some overgrown areas.
- The rate of vertical curvature (Ka) along the I-95 and I-495 mainline consistently does not meet the design criteria for 70 mph, resulting in sight distance issues throughout these corridors.

Vertical Clearance

Construction plans for bridges over I-95 and I-495 were obtained from the MassDOT for the study area. These were reviewed in conjunction with mainline resurfacing plans to identify the current vertical clearance. The following bridges, shown graphically in Table 2-40 do not meet the MassDOT standard of 16 ft 6 in vertical clearance:

Table 2-40 Vertical Clearance Deficiencies

Bridge Number	Location	Vertical Clearance
A-16-40	Railroad bridge over I-95, Attleboro	14 ft 3-1/8 in
A-16-41	Bacon Street over I-95, Attleboro	14 ft 3-5/8 in
A-16-51	Clifton Street over I-95, Attleboro	14 ft 1-7/8 in
N-16-47	Robert F. Toner Boulevard over I-95, North Attleborough	16 ft 2 in
F-6-27/M-3-27	I-495 southbound over I-95 southbound, Foxborough	16 ft 3-1/2 in
F-6-26	Green Street over I-495 southbound, Foxborough	16 ft 1 in
F-6-25	South Street over I-495 southbound, Foxborough	16 ft 1 in
F-6-23	Spruce Street over I-495 southbound, Foxborough	16 ft 1 in
W-46-11	Taunton Street over I-495 southbound, Wrentham	16 ft 2-1/2 in
W-46-8	West Street over I-495, Wrentham	16 ft 2-1/8 in

I-95 Interchanges

A detailed evaluation of the entire I-95 and I-495 corridors was completed as part of this assessment. Using the design criteria noted in Table 2-38and 2-39, each of the interchanges along the corridor was assessed and a number of instances were noted where the current layout does not meet the current design guidelines. For more information relating to the design review, the specific issues identified are provided as an attachment to this chapter.

2.8.2 Bridge Assessment

There are numerous bridges in the study area that are routinely inspected by MassDOT using National Bridge Inspection Standards (NBIS). The primary purpose of the NBIS is to locate, evaluate, and act on existing bridge deficiencies to ensure that the bridges are safe for the traveling public. Evaluation of each bridge's load-carrying capacity is an essential part of the procedure. Each NBIS bridge is inspected at regular intervals of two years with certain types or groups of bridges requiring inspections at less than two-year cycles.

Bridges are considered structurally deficient if significant load-carrying elements are found to be in poor or worse condition due to deterioration and/or damage, or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to the point of causing intolerable traffic interruptions. The fact that a bridge is "deficient" does not immediately imply that it is likely to collapse or that it is unsafe. With hands-on inspection, unsafe conditions may be identified and, if the bridge is determined to be unsafe, the structure must be closed. A "deficient" bridge, when left open to traffic, typically requires significant maintenance and repair to remain in service and eventual rehabilitation or replacement to address deficiencies. To remain in service, structurally deficient bridges are often posted with weight limits to restrict the gross weight of vehicles using the bridges to less than the maximum weight typically allowed by statute.

Functional obsolescence is a function of the geometrics of the bridge in relation to the geometrics required by current design standards. While structural deficiencies are generally the result of deterioration of the conditions of the bridge components, functional obsolescence results from changing traffic demands on the structure. Facilities, including bridges, are designed to conform to the design standards in place at the time they are designed. Over time, improvements are made to the design requirements. As an example, a bridge designed in the 1930s would have shoulder widths in conformance with the design standards of the 1930s. However, the design standards have changed since the 1930s. Therefore, current design standards are based on different criteria and require wider bridge shoulders to meet current safety standards. The difference between the required, current-day shoulder width and the 1930s designed shoulder width represents a deficiency. The magnitude of these types of deficiencies determines whether the existing conditions cause the bridge to be classified as functionally obsolete.

According to MassDOT there are three structurally deficient bridges in the study area:

- East Street over Route 1 in Westwood;
- Providence Highway over Harris Street and High Street in Dedham; and
- Boston-Providence Turnpike over Mother Brook in Dedham (just north of the Dedham Mall).

There are no functionally obsolete bridges in the study area, according to MassDOT.

2.9 Environmental Resources

This section documents the existing environmental conditions within the study area. Base mapping procedures and environmental resources are discussed in detail. The environmental resources discussed in this section will help guide the development of alternatives so that impacts to the environment are avoided, minimized, or appropriately mitigated.

Environmental resource mapping for the I-95 Study area was developed primarily using Massachusetts Geographic Information System (MassGIS) data (http://www.state.ma/us/mgis/massgis.htm). MassGIS is a part of the Executive Office of Energy and Environmental Affairs (EOEEA). In addition to using MassGIS as a resource, additional information on open space and historic areas was obtained from both local towns as well as the Massachusetts Historic Commission (MassHistoric). The environmental resources in the study area along I-95, I-495, and Route 1 which include:

- **Department of Environmental Protection (DEP) Wetlands** – Wetlands and upland areas are protected by state and federal laws and Executive Order 11990.

  A number of wetland resource areas exist within the vicinity of the study area, which are regulated under a combination of regulatory programs. These programs include:

  - The Massachusetts Wetlands Protection Act (WPA), MGL Chapter 131, Section 40 and its implementing regulations, 310 CMR 10.00;
  - Section 401 of the Clean Water Act (CWA) and its implementing regulations, 314 CMR 9.00;
  - Section 404 of the CWA; and
  - Any local bylaws of the towns within the Study area.

  The wetland resource systems include wooded swamps, scrub-shrub swamps, marshes and wet meadows that border or contain streams and ponds and isolated wetlands that may annually confine more than 0.25 acre-feet of water, although more detailed calculations would be needed to determine this precisely. Protected resource areas associated with these systems include Land Under Water Bodies and Waterways (LUWW), Bank, Bordering Vegetated Wetland (BVW), Bordering Land Subject to Flooding (BLSF), Isolated Land Subject to Flooding (ILSF) and Riverfront Area. The WPA establishes a 100-foot buffer zone from the limit of Bank (if not bordered by wetland) and/or BVW associated with these wetland systems. Additionally local bylaws may set additional buffer zones extending from wetland limits.

- **Natural Heritage and Endangered Species Program (NHESP)** – Rare species are important to biodiversity because they represent elements of an ecological system that are unique or few in numbers. Federal and state laws protect rare plants and animals and their critical habitats. The Figures A-1 through A-8 show the limits of the rare species habitats mapped by the Massachusetts Natural Heritage and Endangered Species Program (NHESP).

- **Vernal Pools -** Mapping maintained by MassGIS indicates the presence of numerous potential vernal pools within the study area. These areas have not been inspected to determine their ability to provide successful amphibian breeding habitat, but are shown to identify the potential location of breeding habitats. Should future alternatives impact these potential locations, additional inspection may be needed. Additionally, according to the atlas produced by NHESP[3], three certified vernal pools occur north of I-495 in Wrentham, Massachusetts. The certified vernal pools as well as the potential vernal pools are shown in the Figures A-1 through A-8.

- **Outstanding Resource Waters and Critical Areas** - Based on mapping maintained by MassGIS and a published atlas,[4] there is one section of the study area that has been deemed an Outstanding Resource Water:

  Manchester Pond and Orrs Pond are located in the City of Attleboro. They are contributors to the public drinking water supply; more specifically Manchester Pond serves as the area's reservoir.

3 NHESP, 2008. *Massachusetts Natural Heritage Atlas, 13th Edition.*
4 DEP, 1993. *Designated Outstanding Resource Waters of Massachusetts.*

- **Historic Districts** – Federal policy set forth in the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470 et seq.) includes preserving "the historical and cultural foundations of the Nation" and preserving irreplaceable examples important to our national heritage to maintain "cultural, educational, aesthetic, inspirational, economic, and energy benefits". As specific recommendations are made and alternatives are developed for this project, permits from the Federal and Massachusetts state agencies will be subject to compliance with the above noted regulations.

  As part of this research, a detailed review of the current archaeological and architectural site files and records was conducted with the Massachusetts Historical Commission (MHC) to determine which listed or inventoried ground and archeological resources were within a ¼ mile buffer area of the study area roadways. In summary, 68 buildings and structures were marked as "inventoried" properties and 3 of these were also listed on the National Register of Historic Places with another two properties noted as "being eligible" for inclusion on the National Register of Historic Places. This information identifies the specific properties which were included in the evaluation. As alternatives are developed that have the potential to impact these locations, additional research will need to be conducted to determine the exact nature of these historical resources as well as the possible outcomes of any direct or indirect impact to them.

- **Recreational and Open Space** – The individual Towns and State maintain an inventory of parcels of land that are designated recreational and open spaces. These parcels can be either publicly or privately owned and include parks, conservation land, libraries, recreational areas, and cemeteries. Parcels of private land are primarily protected as open space through conservation or agricultural restrictions. Publicly owned open space may be protected through Section 4(f) of the Department of Transportation Act or Section 6(f) of the Land and Water Conservation Fund Act. A conservation restriction is a legally binding agreement between the landowner and a holder – usually a public agency or a private land trust; whereby the landowner agrees to limit the use of their property for the purpose of protecting certain conservation values. The conservation restriction may run for a period of years or in perpetuity.

All of the geometric deficiencies, historic inventories, and environmental resources shown in the attached set of Figures A-1 through A-8 and will serve as a guide during the development and evaluation of transportation improvement alternatives.

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3

Future Conditions

This chapter describes the future transportation conditions within the study area. Sections of this chapter present an overview of the travel demand forecasting process, identification of known roadway and infrastructure improvements planned for the study area, study area demographic projections, the future traffic demands and operations, the impacts of these demands on the infrastructure capacity, and a summary of the future deficiencies/needs of the corridor.

Background information about this project, and the existing conditions were presented in Chapters 1 and 2. Subsequent chapters will present the improvement alternatives, the final recommendations, and the plan of action for the corridor. At the completion of this study, a comprehensive final report will be prepared that considers comments received.

The nature of this study requires forecasting travel demands and patterns to define recommended improvements that provide sustaining benefits to the traveling public. A 2030 planning horizon year was chosen for this study to ensure that proposed improvements are "visionary" providing long-term benefits for the I-95 corridor and the region.

3.1 Travel Demand Forecasting

Once existing traffic volumes have been quantified (as in Chapter 2), predicting changes in future traffic demand is best accomplished through understanding and mapping changes in land uses and demographics and inputting this information into a travel forecasting model. To accomplish this task, the Massachusetts Statewide Travel Demand Model (the “model”) was used to predict future traffic volumes on roadways within the study area for the design year 2030. The model is highly data- intensive and requires the following inputs to generate traffic volume projections:

- A schematic roadway network of major and secondary roads within the state. Each road's characteristics such as length, number of lanes, capacity, and travel speed are entered into the model. Changes to the roadway network expected before 2030, such as widening that will increase roadway capacity (planned roadway improvements) are also entered into the future year model.
- A detailed zone (or land area) structure throughout the state generally based on Census Block Groups with various load points for trips from each zone to access the roadway network. All towns within the state are broken down into smaller zones. Trips originating in each zone are loaded onto the schematic roadway network.
- Projections of future (2030) population and employment data for each of the zones.

The model uses the population and employment data from each zone to generate a trip table that represents the travel demand on a daily basis between it and all the other zones in the model. Travel demands, or trips, are then assigned to the roadway network, taking into account the roadway characteristics and travel times to determine the actual route a trip might take to travel from one zone to another. The statewide model is maintained by MassDOT staff and is routinely updated to account for physical changes to the roadway network and employment projections. The resulting growth in trip ends within each zone is shown graphically in Figure 3-1.

3.2 Study Area Demographic Projections

This section provides an overview of the transportation-related demographic projections for the study area communities based on a review of the corridor information as well as from output provided by the regional travel demand model. These include household, population, and employment data. This demographic data will ultimately be used to help identify growth nodes within the study area and assist in developing a needs assessment and series of improvement recommendations.

The travel demand model that was developed by MassDOT and CTPS considers the input from each of the various communities with the Commonwealth. The future land use assumptions have been thoroughly vetted with each community individually prior to this study. The model consolidates this input and provides a basis from which to provide reasonable projections of potential future growth on a regional basis. The following provides a summary of the output of this model on a regional and community-by-community basis for the study area.

3.2.1 Households and Population

Table 3-1 displays household, population, and employment by jurisdiction and compares 2010 and 2030 travel demand model projections to show regional growth patterns within the study area.

Based on the travel demand model, the I-95 South Corridor area will have approximately 106,600 households in 2010 and 125,000 households in 2030. This represents an approximately 17.4 percent increase in households over twenty years. The population estimates from the model indicate that the area will have approximately 274,000 residents in 2010 and 307,000 residents in 2030, representing a 12.1 percent increase over the twenty year horizon. It should be noted that the 2010 demographic information described above represents model projections and not actual conditions.

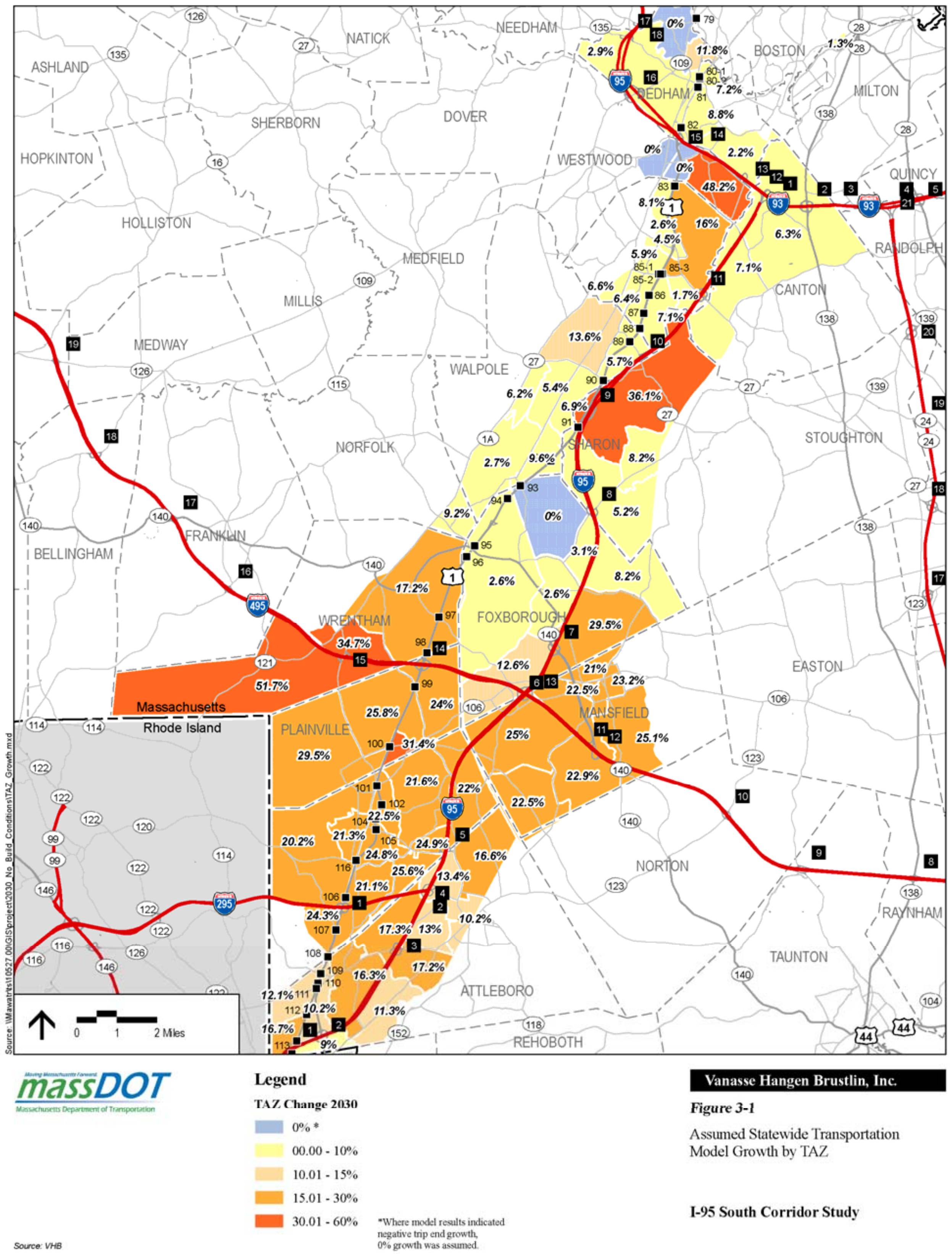

Figure 3-1
Assumed Statewide Transportation Model Growth by TAZ

Table 3-1 Household, Population, and Employment Growth by Jurisdiction

	Household			Population			Employment		
Community	2010	2030	Percent Growth	2010	2030	Percent Growth	2010	2030	Percent Growth
Attleboro	17,620	20,642	17.2%	46,071	54,109	17.4%	23,968	24,958	4.1%
Canton	8,949	10,517	17.5%	21,643	22,866	5.7%	21,206	23,016	8.5%
Dedham [1]	10,052	10,932	8.8%	25,879	26,317	1.7%	15,009	15,475	3.1%
Foxborough [2]	6,864	7,908	15.2%	17,347	18,880	8.8%	9,409	9,902	5.2%
Mansfield	10,274	13,581	32.2%	25,055	30,355	21.2%	14,301	17,091	19.5%
North Attleborough	11,433	13,225	15.7%	29,710	34,871	17.4%	15,060	19,015	26.3%
Norwood	12,447	13,812	11.0%	29,216	30,324	3.8%	25,137	26,530	5.5%
Plainville	3,294	4,020	22.0%	8,551	10,288	20.3%	3,856	5,205	35.0%
Sharon [3]	6,464	7,216	11.6%	18,315	19,615	7.1%	3,371	3,615	7.2%
Walpole	8,882	10,150	14.3%	23,828	25,244	5.9%	9,892	10,354	4.7%
Westwood	6,192	7,672	23.9%	15,850	18,269	15.3%	11,619	12,803	10.2%
Wrentham	4,114	5,424	31.8%	12,435	15,885	27.7%	5,058	5,849	15.6%
Total	106,585	125,099	17.4%	273,900	307,023	12.1%	157,886	173,813	10.1%

1 Dedham projections do not include the full-build out of Legacy Place and therefore the household, population, and employment estimates for this community are not representative of expected future conditions.

2 Foxborough projections do not include the full-build out of Patriot Place and therefore the household, population, and employment estimates for this community are not representative of expected future conditions.

3 Sharon projections do not include the full-build out of Sharon Commons and therefore the household, population, and employment estimates for this community are not representative of expected future conditions.

3.2.2 Employment

As shown in Table 3-1, employment estimates from the model show that there will be approximately 157,900 jobs in study area towns in 2010 and 173,800 jobs in study area towns in 2030. This represents an approximately 10.1 percent increase in jobs in the study area over twenty years. It should be noted that the 2010 employment information described above represents model projections and not actual conditions.

It should be noted that these employment estimates reflect the number of jobs that exist in each of the study area communities and not the employed residents in each community, or labor force, as was presented in Chapter 2. It should also be noted that there are several large-scale projects not considered in the model as well which are discussed later in this report.

3.2.3 Land Use

As part of the public outreach process, the Working Group and study area communities were asked to provide input on future land use for the study area by identifying planned as well as speculated development within each of the cities and towns in the study area to verify/update the information in the statewide travel demand model. Representatives of each community were asked to provide information relative to what types of development or expansions of existing land uses were likely to occur through the year 2030 and where these might occur. Similarly, the master plans for many of the communities (where they existed) were also reviewed to cross-check for other potential growth areas within the region. Meeting summaries containing information received from the Working Group and the community outreach effort is provided in the Appendix to this report.

The information and data compiled from this effort were compared with population and employment forecast data already in the statewide model. This analysis found that the population and employment growth inputs to the model are very consistent with anticipated land use changes in the I-95 study area. Only three traffic analysis zones required manual adjustments to account for more intense development than was considered in the statewide model. The three developments that required manual adjustments to statewide model projections are the Legacy Place development in Dedham, Patriot Place development proposal in Foxborough, and the Sharon Commons development in Sharon. Manual adjustments were made to traffic patterns based on the traffic impact and access studies prepared by the developers and previously reviewed as part of overall Massachusetts Environmental Policy Act processes for these projects.

3.3 2030 Future Transit Forecasts

Transit projections were researched through discussions with the specific providers, CTPS, and both MAPC and SRPEDD. In these discussions, it was clear that commuter rail projections for all lines south of Boston are projected to increase by as much as 40 percent with some specific lines increasing at higher percentages than others. That being said, there is a very real acknowledgement by most participants to this effort that there are existing capacity constraints on certain lines. Specifically, within the study area, the two major commuter rail lines, Attleboro/Stoughton (25,000 daily boardings) and Franklin (14,000 daily boardings), are expected to see little to no ridership growth under their current operational system. This is because both lines are essentially at their capacity from a ridership perspective as well as a lack of additional parking at most of the train stops along these lines. Absent the ability to increase the number of options for riders (more trains, more seats, and/or more efficiency) and/or the provision of additional parking at these stations, there will likely be little to no additional ridership growth along the two major lines within the study area.

Similarly, the MBTA and GATRA bus options provide localized services and, in some cases, direct connections to both commuter rail stations as well as limited direct service to the Greater Boston area. Under their current organization, these services will likely see growth in ridership commensurate with traffic growth projections for the specific areas of the study area that they serve.

Ultimately, in the absence of any changes to the organizational or operational structures of the transit services (bus, commuter rail, and para-transit) in the region, there will be limited growth in ridership projections. That being said, an important component of this study will be to consider the impact of transit alternatives in the following chapters of this effort.

Consideration should be given to the influence of the Commonwealth's South Coast Rail project and how it could influence traffic patterns within and along the I-95 and Route 1 corridors. While there has been no specific 'preferred' alternative developed at this point in time, any option that is considered for advancement will need to be considered in the future development of the alternatives for this effort. Certainly, it is expected that any option developed for the South Coast Rail project will likely have some level of impact on transit ridership along this study's corridors as well as potential impacts to the traffic volume projections along and through the corridor.

3.4 2030 Future Traffic Demand

Based on the travel demand model projections, daily growth was obtained from the model for the mainline segments, ramps, weaving segments, and key intersections in the study area. Because the model is geared towards the daily traffic projections (as opposed to peak hour projections), the daily growth values within the study area were utilized as the basis for projecting future volumes in the region. These percentages were then applied to the existing morning and evening peak hour volumes to provide a reasonable projection of hourly volume adjustments. To account for the traffic impacts associated with the Legacy Place, Sharon Commons, and Patriot Place developments, traffic projections provided in the associated MEPA/permit filings were added to these traffic volumes.

The resulting 2030 Baseline traffic volumes consider the existing and future traffic volumes within the project study area and provide a reasonable basis from which to begin to identify long-term transportation issues within the region. Traffic volume networks representing the 2030 Baseline Condition for the weekday morning and weekday evening peak hours are provided in the Appendix.

3.4.1 Projected Growth Rate

The total growth based on the travel demand model projections was applied to the mainline segments, ramps, weaving segments, and key intersections in the study area. Table 3-2 and Table 3-3 present a comparison of the 2008 and 2030 weekday morning and evening peak hour traffic volumes for I-95 and I-495 mainline segments, respectively. All segments are projected to experience increased traffic demand. It should be noted that the 2030 future volumes account for growth included in the travel demand model projections only and do not include background development trip generation. Specific background development trip generation is discussed in the next section.

Table 3-2 I-95 Mainline Peak Hour Volume Comparison 2008-2030[1]

I-95 Northbound

	Weekday Morning Traffic Volumes			Weekday Evening Traffic Volumes		
Segment	2008 Existing	Percent Growth	2030 Future	2008 Existing	Percent Growth	2030 Future
Rhode Island to Exit 1	3,600	8.9%	3,920	3,300	8.9%	3,590
Exit 1 to Exit 2	3,900	8.8%	4,240	3,500	8.8%	3,810
Exit 2 to Exit 3	4,100	6.8%	4,380	3,250	6.8%	3,470
Exit 3 to Exit 4	4,300	6.6%	4,590	3,150	6.6%	3,360
Exit 4 to Exit 5	5,650	7.9%	6,100	4,150	7.9%	4,480
Exit 5 to Exit 6	6,050	7.7%	6,520	4,000	7.7%	4,310
Exit 6 to Exit 7	6,050	7.0%	6,480	3,400	7.0%	3,640
Exit 7 to Exit 8	5,850	8.6%	6,350	3,350	8.6%	3,640
Exit 8 to Exit 9	6,000	9.5%	6,570	3,150	9.5%	3,450
Exit 9 to Exit 10	5,150	14.6%	5,900	3,050	14.6%	3,490
Exit 10 to Exit 11	5,550	16.0%	6,440	3,400	16.0%	3,940
Exit 11 to Slip Ramp	4,950	23.2%	6,100	3,250	23.2%	4,000
Slip Ramp to Exit 12	4,950	18.4%	5,860	3,250	18.4%	3,850

I-95 Southbound

	Weekday Morning Traffic Volumes			Weekday Evening Traffic Volumes		
Segment	2008 Existing	Percent Growth	2030 Future	2008 Existing	Percent Growth	2030 Future
Exit 12 to Slip Ramp	2,950	15.2%	3,400	5,200	15.2%	5,990
Slip Ramp to Exit 11	3,050	16.6%	3,560	6,100	16.6%	7,110
Exit 11 to Exit 10	3,050	10.0%	3,360	6,100	10.0%	6,710
Exit 10 to Exit 9	2,650	8.2%	2,870	5,500	8.2%	5,950
Exit 9 to Exit 8	2,800	7.9%	3,020	5,900	7.9%	6,370
Exit 8 to Exit 7	3,000	6.0%	3,180	5,600	6.0%	5,940
Exit 7 to Exit 6	3,100	6.5%	3,300	5,650	6.5%	6,020
Exit 6 to Exit 5	3,700	7.2%	3,960	5,900	7.2%	6,320
Exit 5 to Exit 4	3,800	7.1%	4,070	5,650	7.1%	6,050
Exit 4 to Exit 3	2,900	5.6%	3,060	3,800	5.6%	4,010
Exit 3 to Exit 2	2,950	6.3%	3,140	3,550	6.3%	3,770
Exit 2 to Exit 1	3,250	7.0%	3,480	3,400	7.0%	3,640
Exit 1 to Rhode Island	3,150	7.0%	3,370	3,200	7.0%	3,430

1 2030 Future volumes account for model growth only and do not include background development trip generation.

Table 3-3 I-495 Mainline Peak Hour Volume Comparison 2008-2030[1]

I-495 Northbound

	Weekday Morning Traffic Volumes			Weekday Evening Traffic Volumes		
Segment	2008 Existing	Percent Growth	2030 Future	2008 Existing	Percent Growth	2030 Future
Exit 10 to Exit 11	3,600	21.5%	4,370	3,600	21.5%	4,370
Exit 11 to Exit 12	3,000	20.4%	3,610	3,200	20.4%	3,850
Exit 12 to Exit 13	3,900	21.8%	4,750	3,900	21.8%	4,750
Exit 13 to Exit 14	3,600	18.1%	4,330	4,050	18.1%	4,780
Exit 14 to Exit 15	3,400	17.4%	4,070	4,000	17.4%	4,690
Exit 15 to Exit 16	3,400	14.4%	3,970	3,900	14.4%	4,460

I-495 Southbound

	Weekday Morning Traffic Volumes			Weekday Evening Traffic Volumes		
Segment	2008 Existing	Percent Growth	2030 Future	2008 Existing	Percent Growth	2030 Future
Exit 16 to Exit 15	3,600	15.6%	4,160	3,600	15.6%	4,160
Exit 15 to Exit 14	3,650	19.1%	4,350	3,700	19.1%	4,400
Exit 14 to Exit 13	3,800	21.1%	4,600	3,900	21.1%	4,720
Exit 13 to Exit 12	3,500	25.6%	4,400	4,100	25.6%	5,060
Exit 12 to Exit 11	3,000	24.9%	3,750	3,100	24.9%	3,780
Exit 11 to Exit 10	3,300	25.7%	4,150	3,700	25.7%	4,560

Note: Shaded cells denote mainline segments that were adjusted to balance with I-95 ramp volumes.
1 2030 Future volumes account for model growth only and do not include background development trip generation.

3.4.2 Specific Background Project Growth

There are several major developments in the study area that are projected to have an impact on traffic volumes along the I-95, I-495, and Route 1 corridors. Based on a review of land use and demographic growth projections in the model, several of these developments have been included in the background growth rates presented above. The land use assumptions included in the model reflect the full build-out of the Westwood Station development in Westwood and of Mansfield Commons in Mansfield. However, traffic associated with the full buildout of Legacy Place, Sharon Commons, and Patriot Place developments (all large scale commercial developments of various sizes) were not included in model projections. Traffic projections provided in the associated MEPA/permit filings were distributed among the study area to account for these developments. Figure 3-2 presents these five major planned development projects. The sum of the trip end growth per zone presented in Figure3-1 and the trips associated with the major planned development projects represents the total assumed trip end growth and is presented in Figure 3-3.

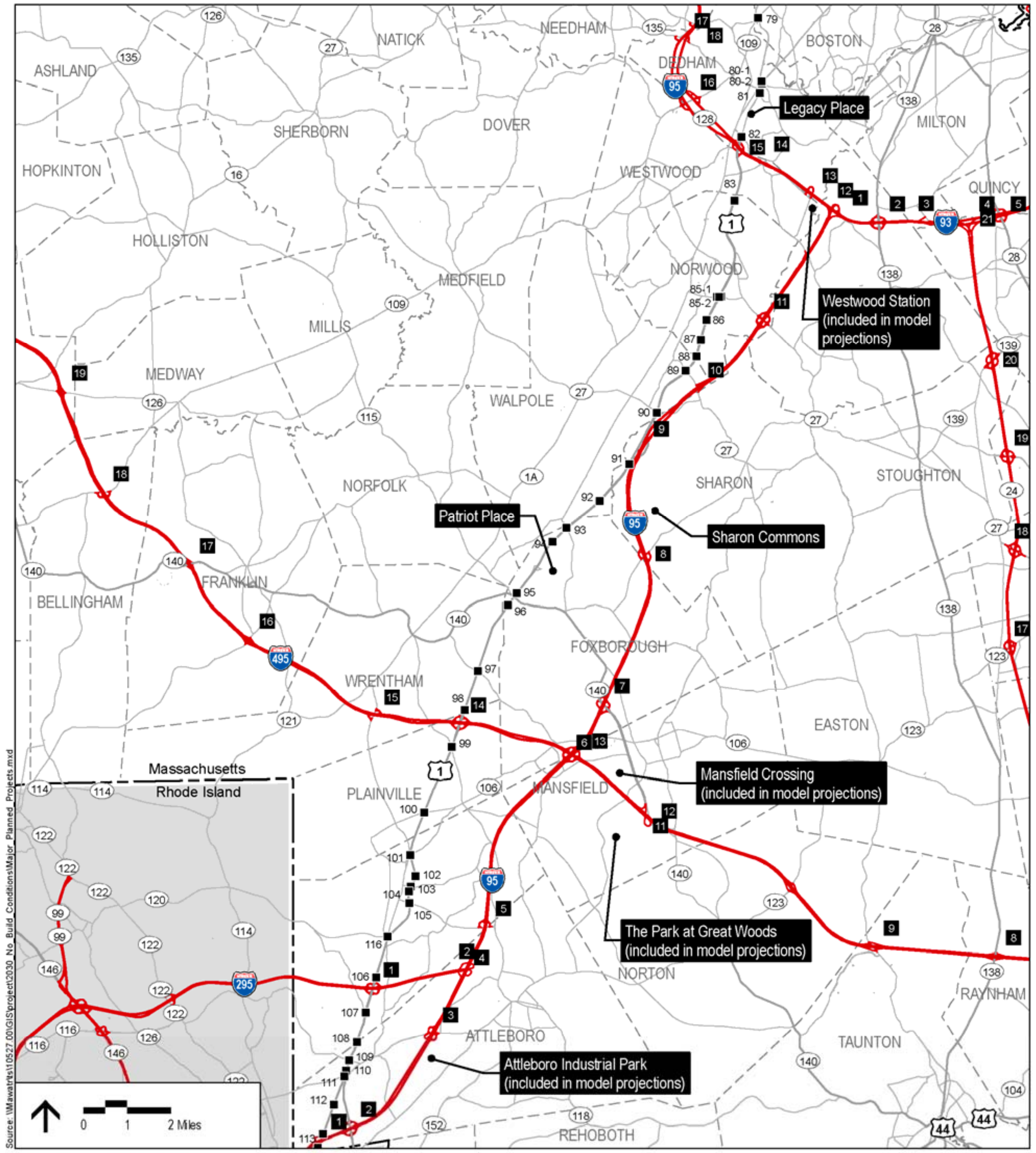

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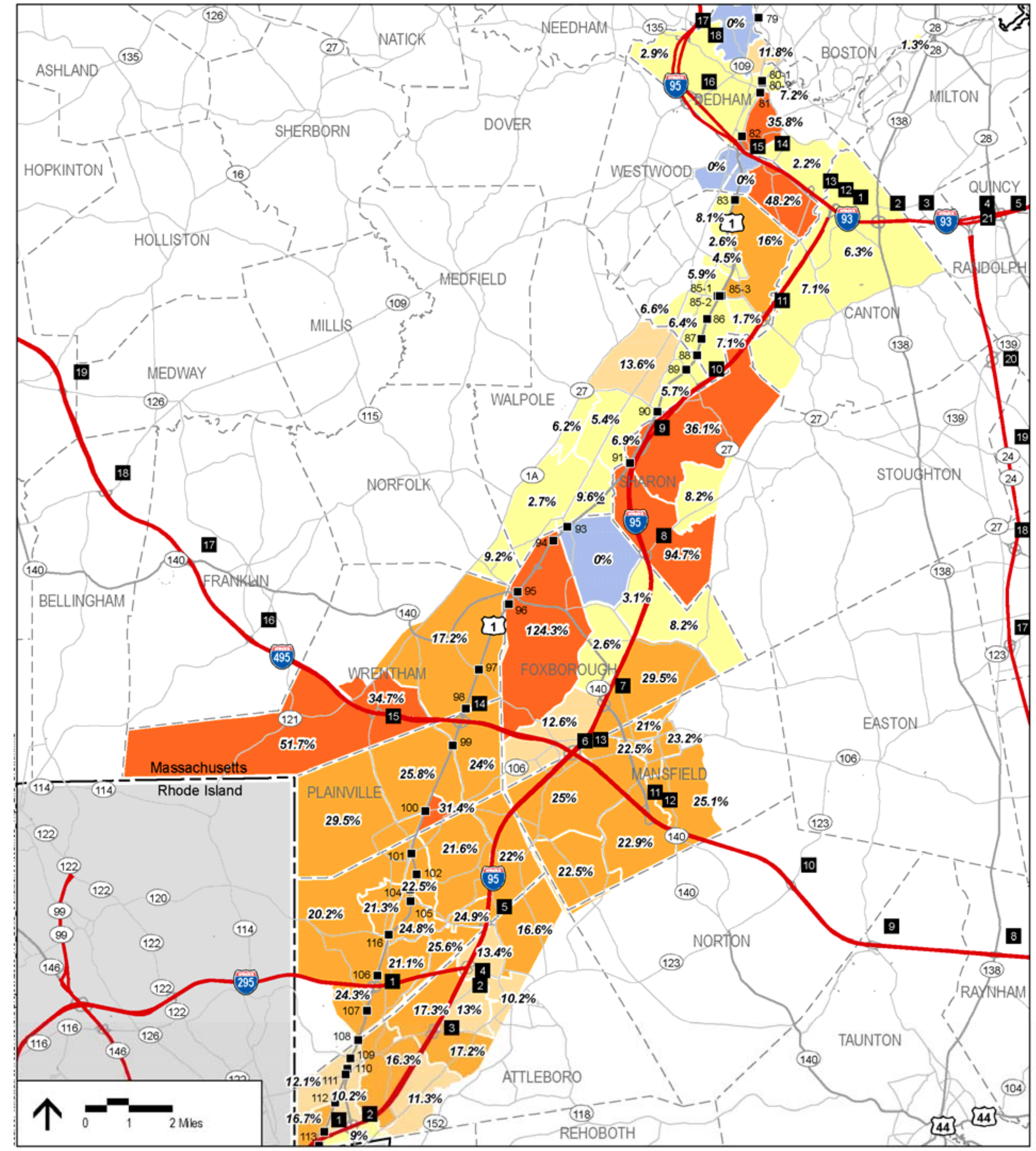
Figure 3-2

Major Planned Development Projects

I-95 South Corridor Study

Source: VHB



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Legend

Assumed Trip End Growth by TAZ

- 0% *
- 0.00 - 10%
- 10.01 - 15%
- 15.01 - 30%
- > 30%

*Where model results indicated negative trip end growth, 0% growth was assumed.

Source: VHB

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Figure 3-3

Composite Transportation Growth by TAZ (Statewide model plus project specific growth)

I-95 South Corridor Study

Legacy Place

As noted previously, traffic associated with the full build-out of the Legacy Place development was not included in model projections. The Legacy Place site is located to the east of Providence Highway, just north of I-95/Route 128 in Dedham, Massachusetts. Primary access will be provided via a site drive along Providence Highway.

At the time of the traffic model development and the localized traffic counts, Legacy Place was under construction. In the autumn of 2009, Legacy Place started to open its doors to the general public. At full build-out, Legacy Place will include 734,000 square feet of mixed-use retail, restaurant, and entertainment space[5]. Traffic volumes projected to be generated by Legacy Place are included in the Appendix.

Sharon Commons

Traffic associated with the Sharon Commons development was not included in model projections. The Sharon Commons site is located to the east of I-95, just north of South Main Street in Sharon, Massachusetts. Primary access will be provided via a new roadway built in the existing right-of-way of Old Post Road.

Sharon Commons is proposed to include 500,000 square feet of mixed-use retail, restaurant, and service space[6]. Traffic volumes projected to be generated by Sharon Commons are included in the Appendix.

Patriot Place

As noted previously, traffic associated with the full build-out of the Patriot Place development was not included in model projections. The Patriot Place site is located approximately three miles from I-95 and four miles from I-495 in Foxborough, Massachusetts with primary access provided via Route 1 (Washington Street).

The two components to this project include the build-out and occupancy of the Patriot Place Phase III mixed-use development and the construction and occupancy of the Patriot Place Phase III-A office/high-tech building development.

The Patriot Place Phase III is a mixed-use development located along the east side of Route 1 adjacent to Gillette Stadium. At the completion of the traffic count program for this study in the fall of 2008, only a portion of the development had been constructed and occupied. The completed elements include the sporting goods retail store, Bass Pro Shops, approximately 360,000 square feet of retail, restaurant and commercial space, and the cinema[7].

The Patriot Place Phase III-A development is located along the west side of Route 1 and includes approximately 790,000 square feet of general office space, 680,000 square feet of high-tech office space, and 150,000 square feet of retail space.

Traffic volumes projected to be generated by the remaining components of the Patriot Place Phase III development and with the Patriot Place Phase III-A development are included in the Appendix.

3.4.3 2020 Baseline Traffic Volumes

The 2030 Future "Baseline" peak-hour traffic volume networks were developed by applying the projected background traffic growth rate to the 2008 Existing Conditions peak hour traffic volumes and then adding the specific peak hour traffic volumes associated with the Legacy Place, Sharon Commons, and Patriot Place developments. The volumes are shown in Figures 3-5 through 3-43.

3.5 Planned Roadway Improvement Projects

Based on a review of previously submitted traffic studies and discussions with MassDOT Highway Division, the Working Group, and community representatives, several specific roadway improvement projects are planned in the study area and are described in detail below. Figure 3-4 provides a graphical summary of where these improvements are planned to take place.

3.5.1 Interstate Improvements

Several interstate improvement projects have been identified that will impact traffic volumes and operations in the future. Because these projects have a more regional impact, they have been included in the travel demand model and their impact is reflected in the 2030 Baseline traffic volumes as well as the analysis. These projects includes:

- Add-a-lane on Route 128 from Route 9 to Route 24;
- Interchange improvements at the I-95/Route 128/I-93 interchange including:
  - New I-95 northbound to Route 128 northbound ramp
  - New I-93 southbound to I-95 southbound ramp
  - Increased speed on all other ramps by 5 miles per hour
  - New I-95 northbound off-ramp (slip ramp) to Dedham Street; and
  - New I-495 southbound on-ramp (slip ramp) from Route 140 at Exit 11

These improvement measures have been included in the 2020 Baseline traffic analysis and their regional impacts have been reflected in the future traffic volumes.

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5 Draft Environmental Impact Report (DEIR) for Planned Commercial Development "Legacy Place"; March 31, 2006.
6 Traffic Impact Report for Sharon Commons; July 2007.
7 Notice of Project Change (NPC) for New Patriots Stadium and Related Infrastructure Project Phase III-A, EEA Number 12037; March 2009.

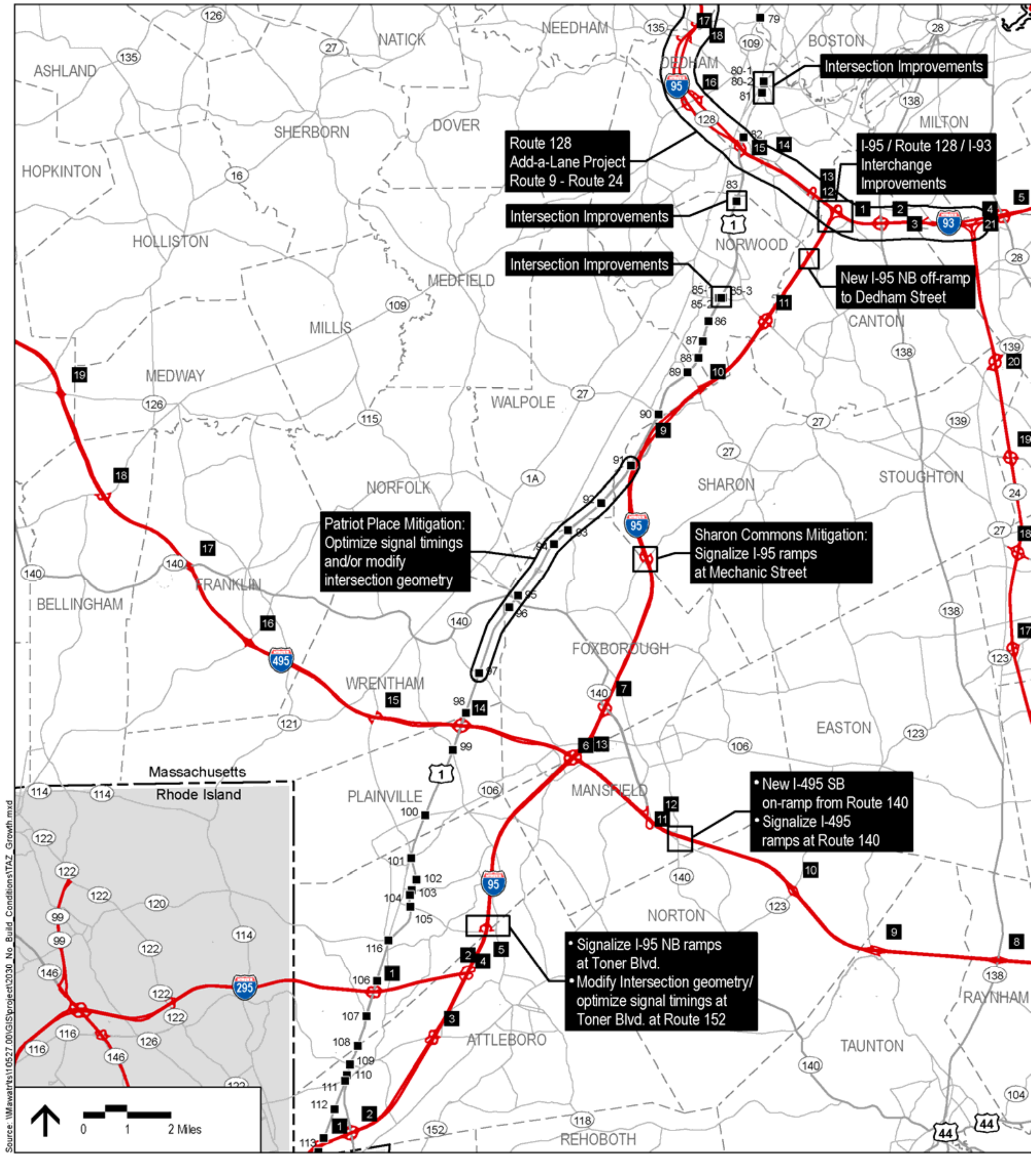

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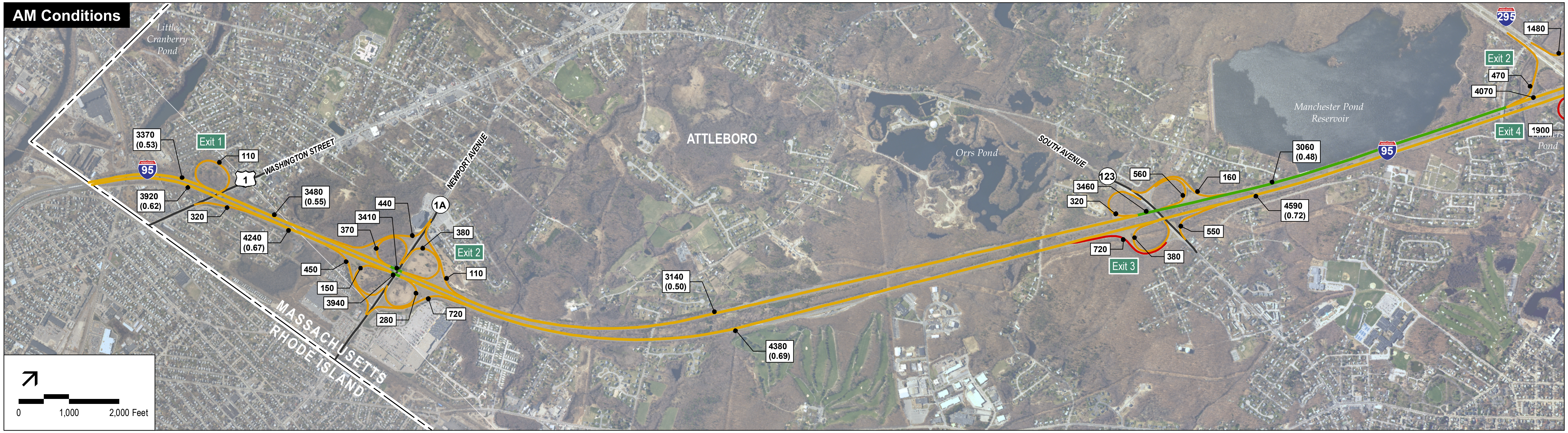
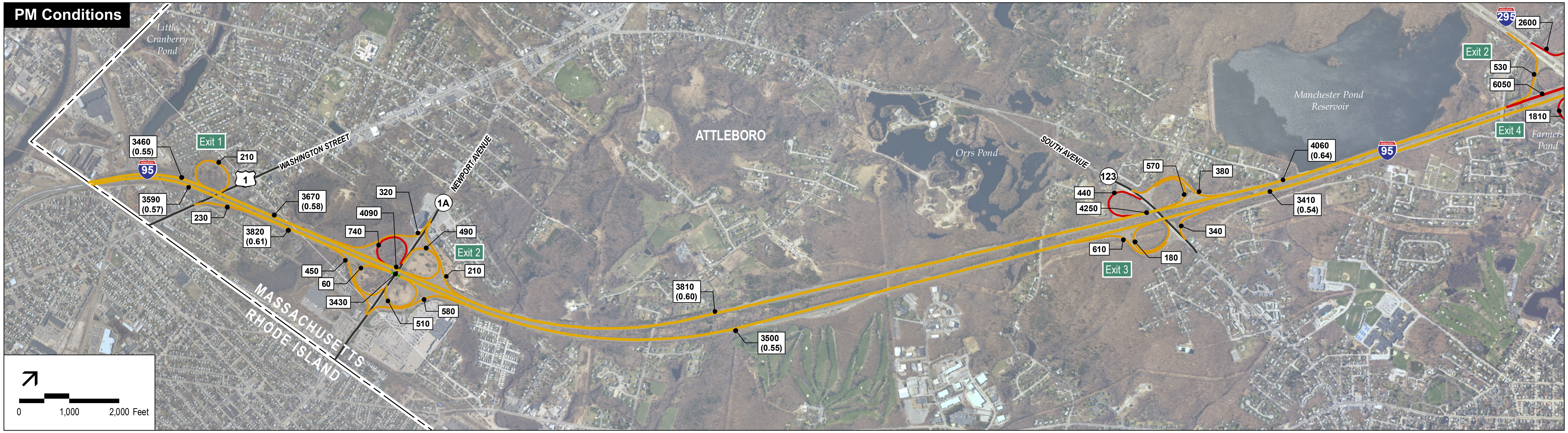
Figure 3-4

Planned Roadway
Improvement Projects

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

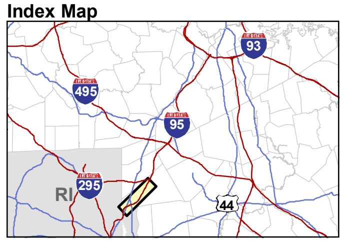

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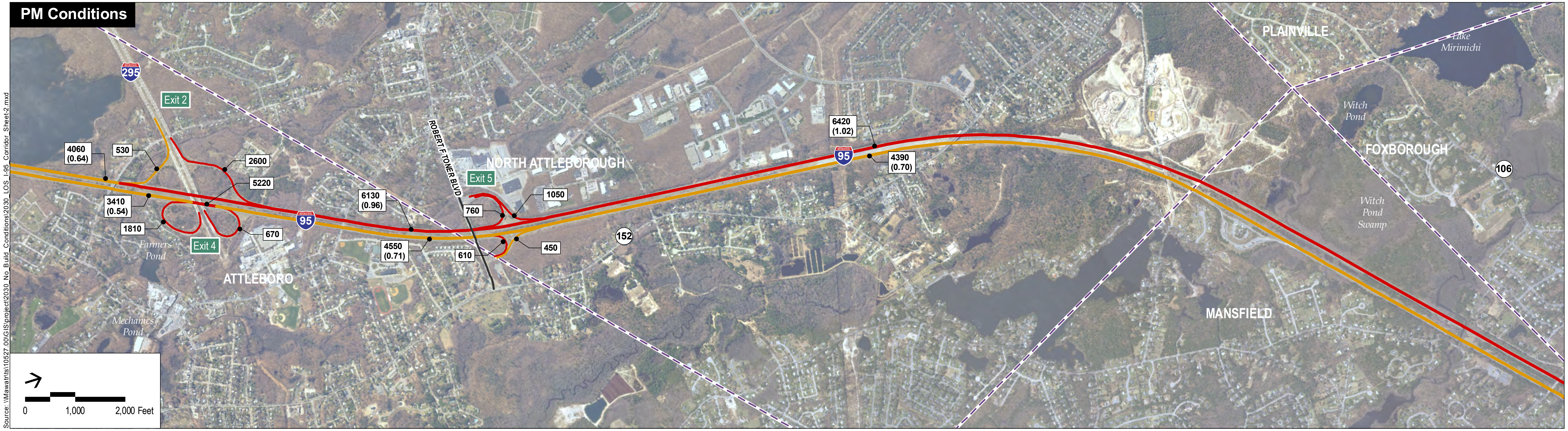
Figure 3-5

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-95 Corridor - Sheet 1 of 5

I-95 South Corridor Study



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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

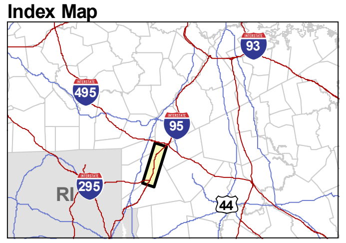

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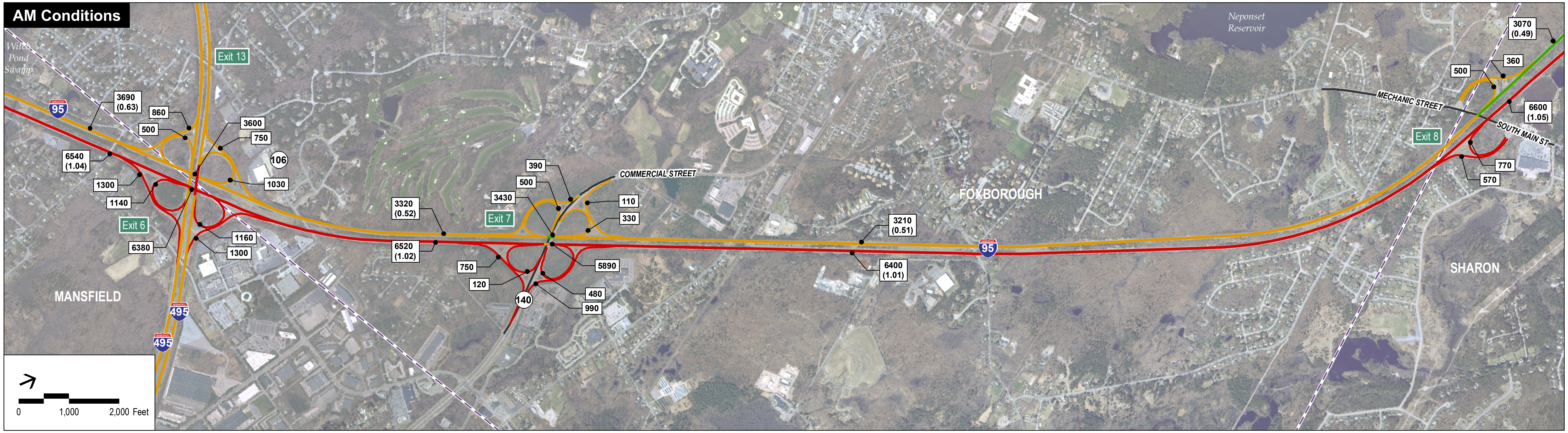
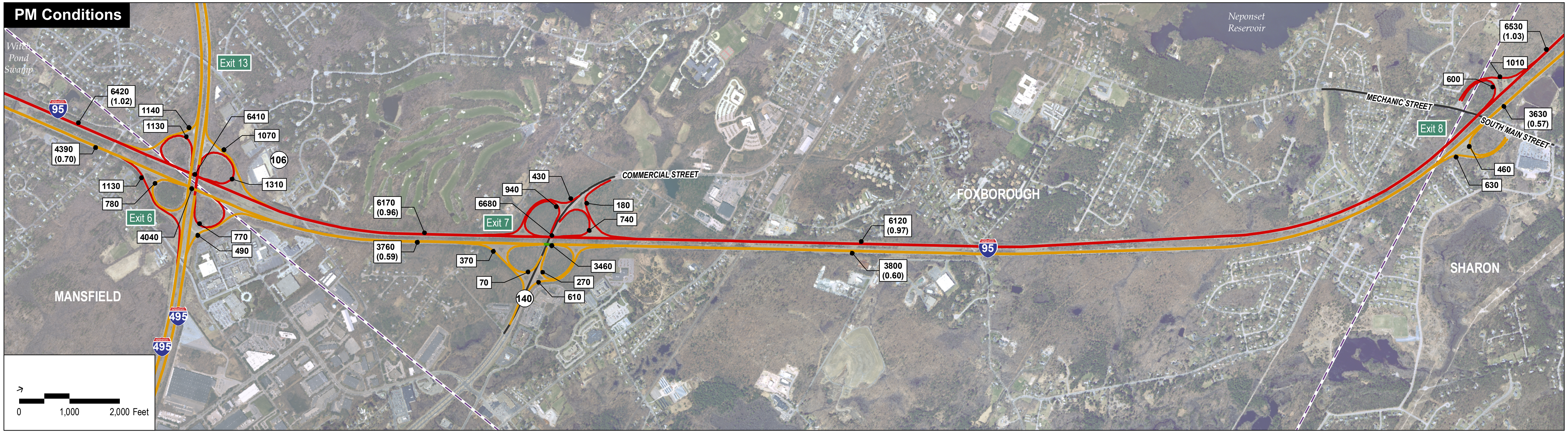
Figure 3-6

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-95 Corridor - Sheet 2 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

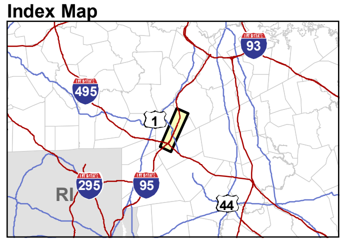

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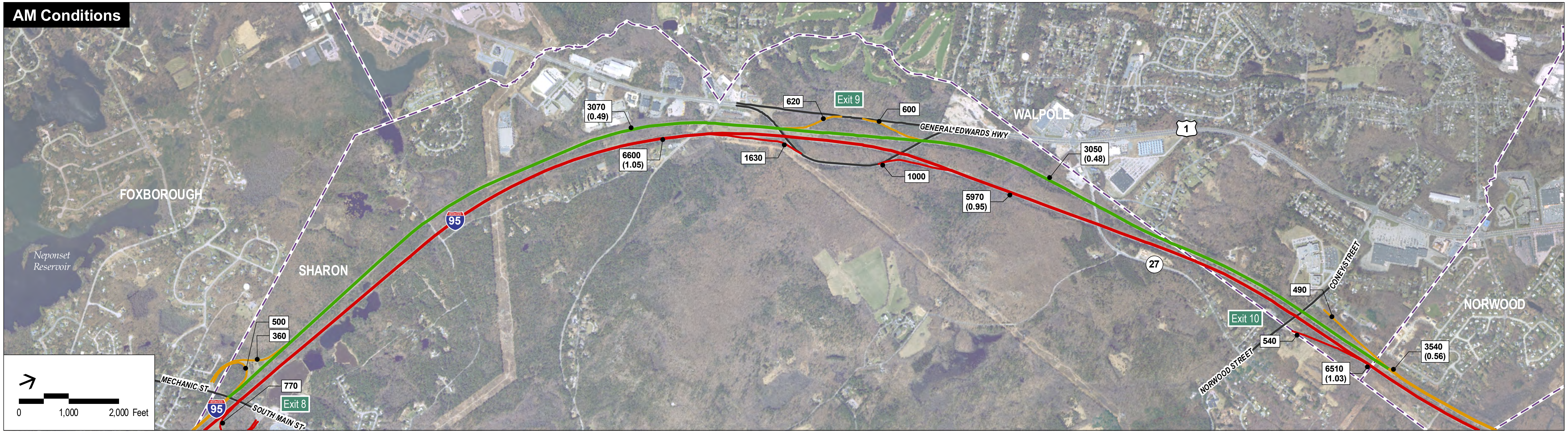
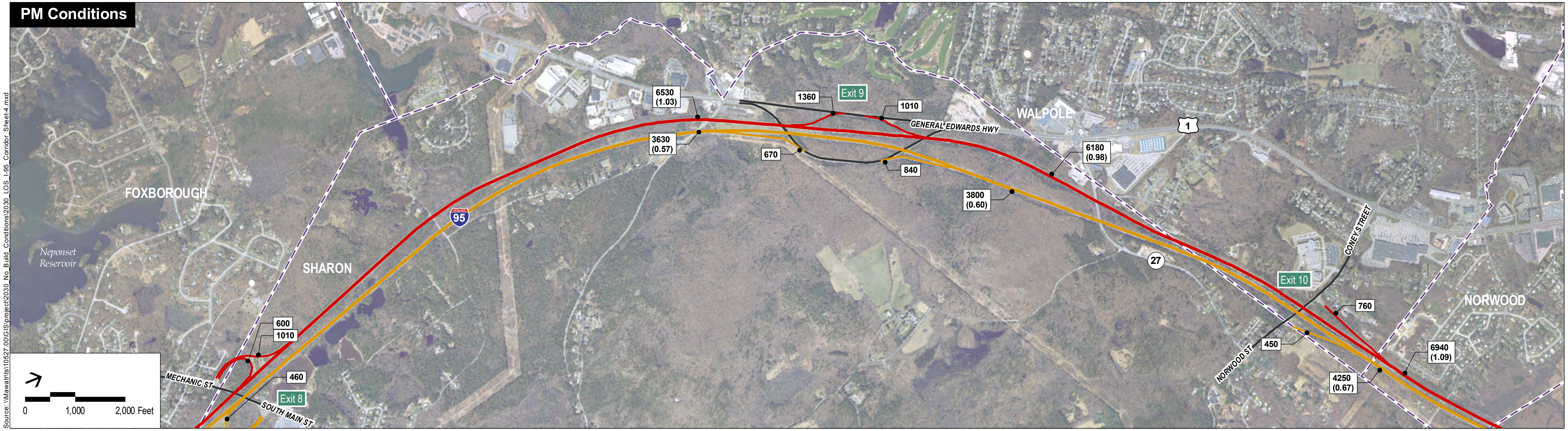
Figure 3-7

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-95 Corridor - Sheet 3 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

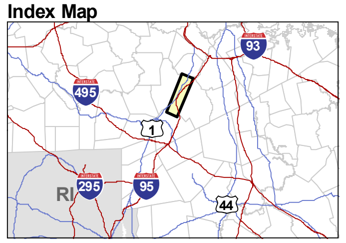

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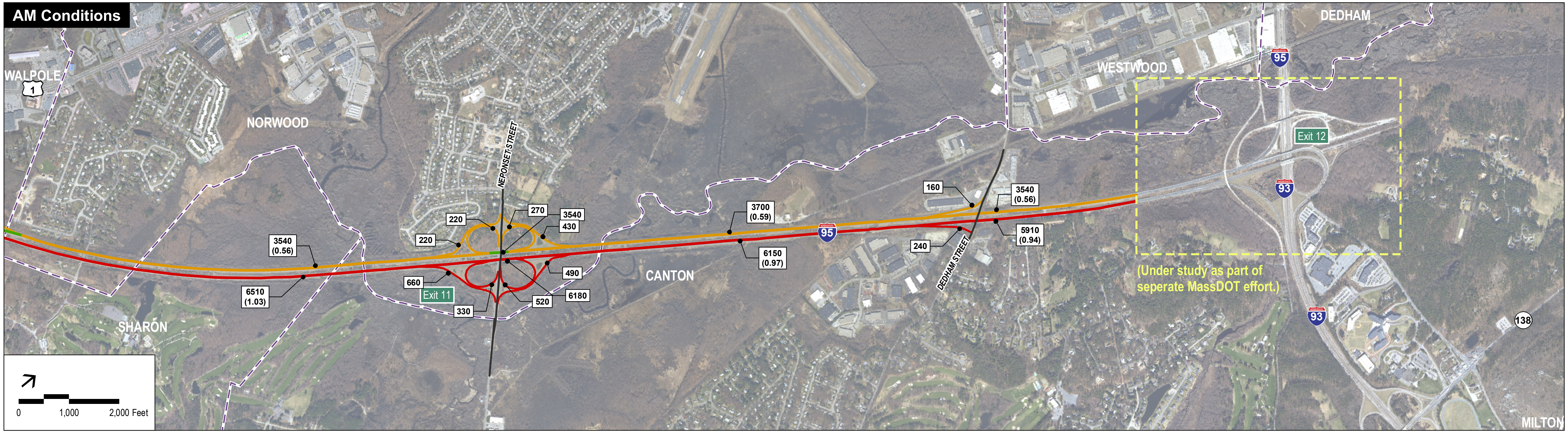
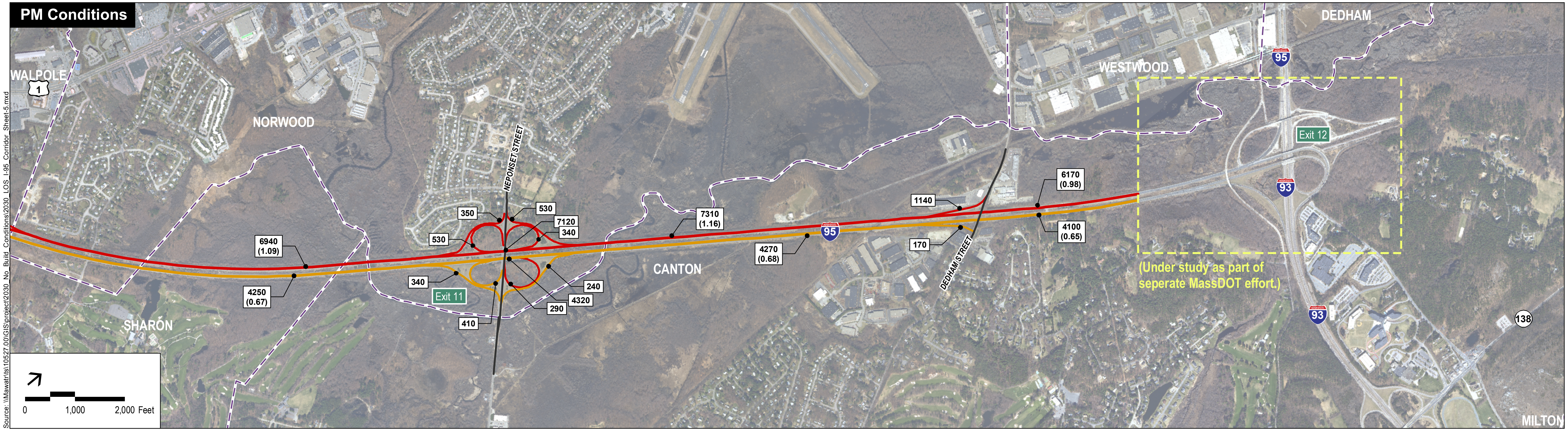
Figure 3-8

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-95 Corridor - Sheet 4 of 5

I-95 South Corridor Study





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Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89)	Volume (Volume/Capacity Ratio)

Index Map

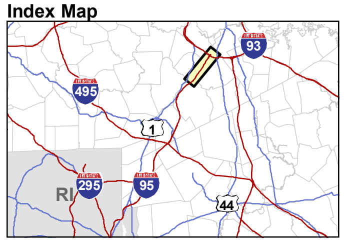

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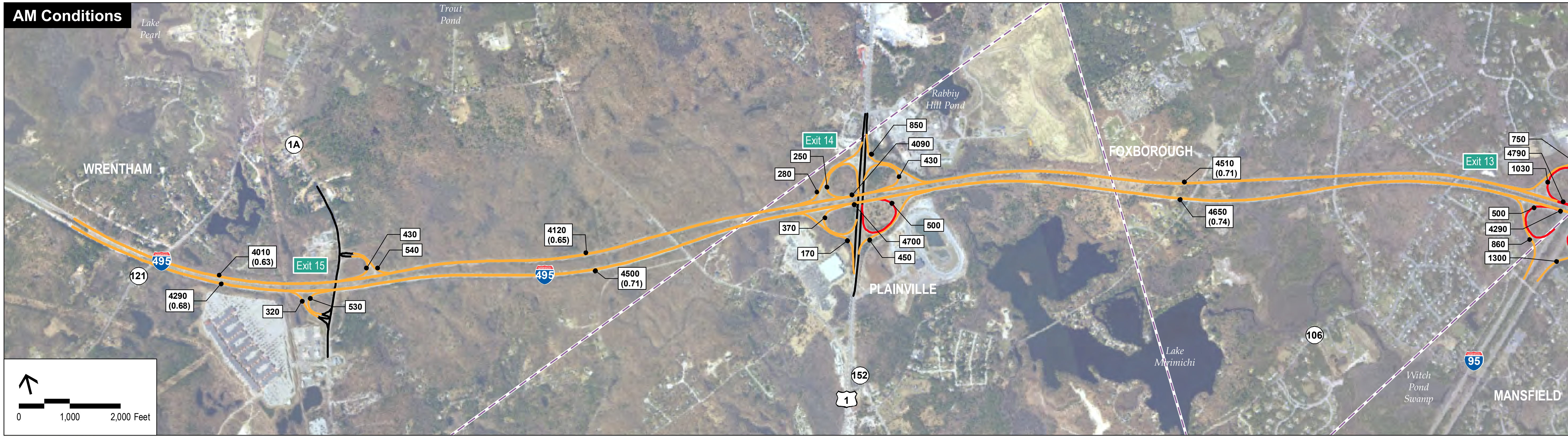
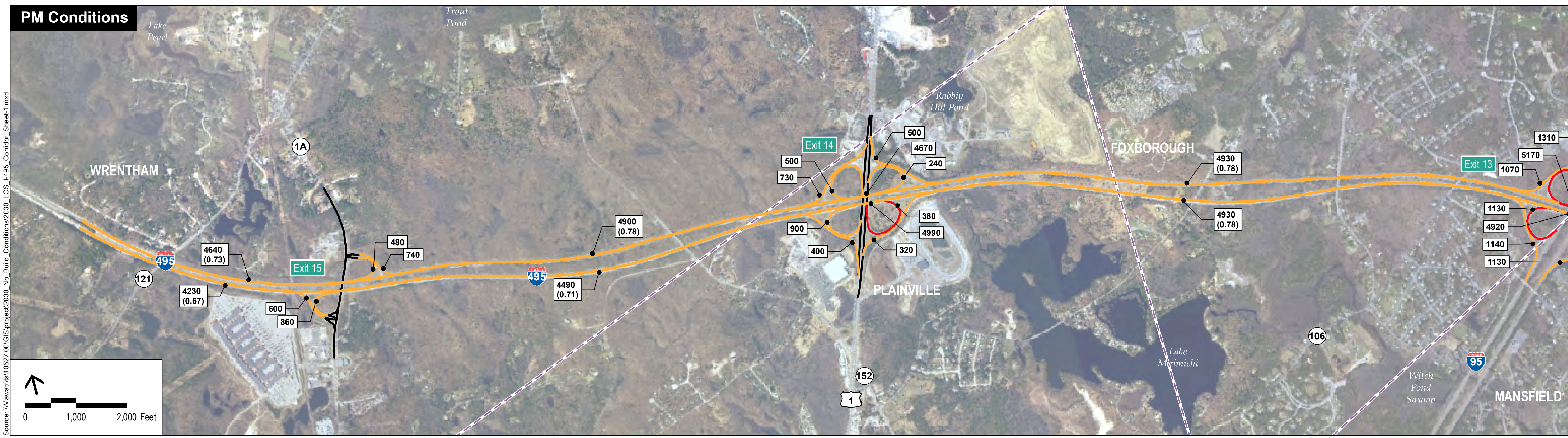
Figure 3-9

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-95 Corridor - Sheet 5 of 5

I-95 South Corridor Study





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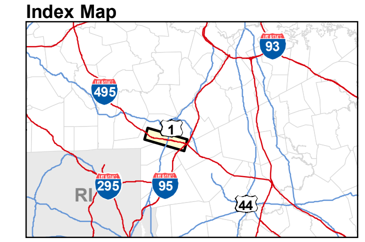
Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F

2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

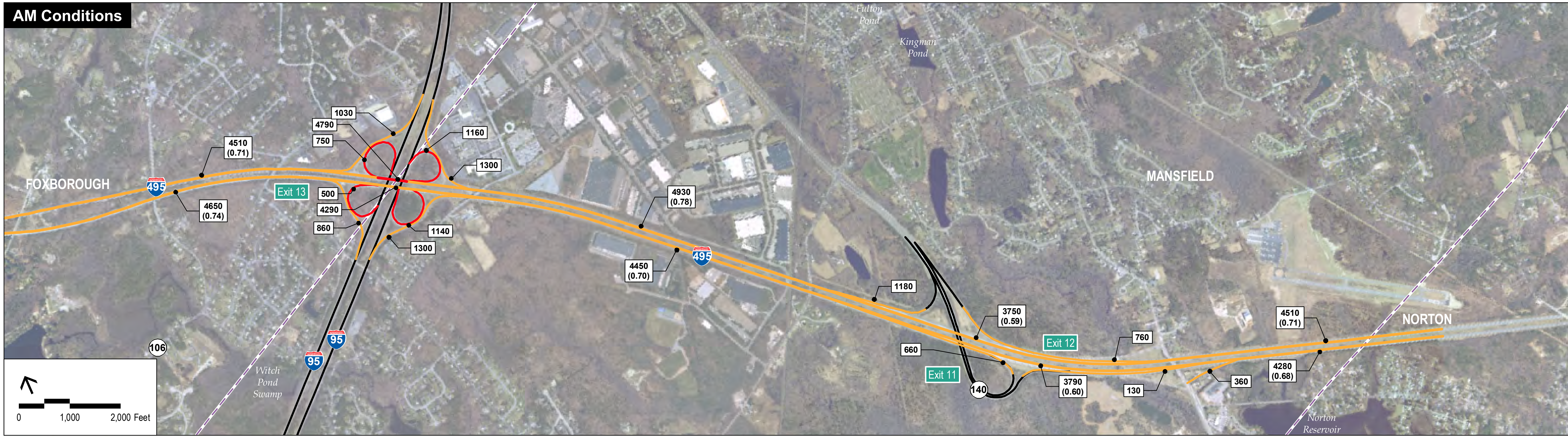


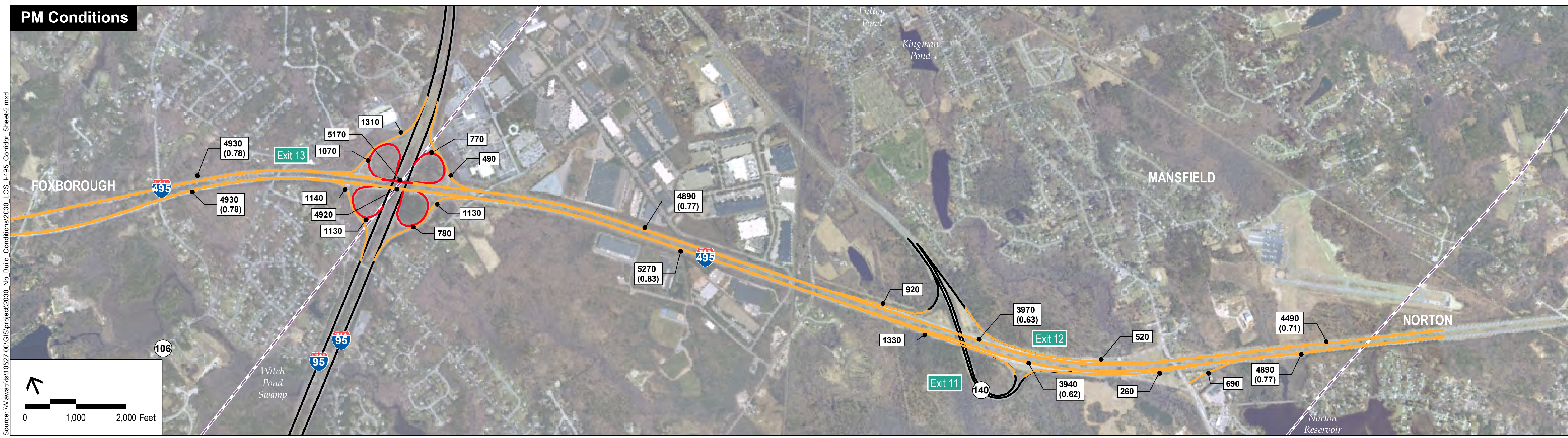
Vanasse Hangen Brustlin, Inc.

Figure 3-10

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-495 Corridor - Sheet 1 of 2

I-95 South Corridor Study





Source: \\Mawarfs\10527.00\GIS\project\2030 No Build Conditions\2030 LOS I-495 Corridor Sheet-2.mxd

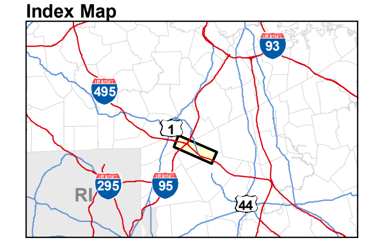
massDOT
Massachusetts Department of Transportation

Legend

Segments and Ramps Level of Service (LOS)

- A/B
- C/D
- E/F
- 2200 (0.89) Volume (Volume/Capacity Ratio)

Index Map

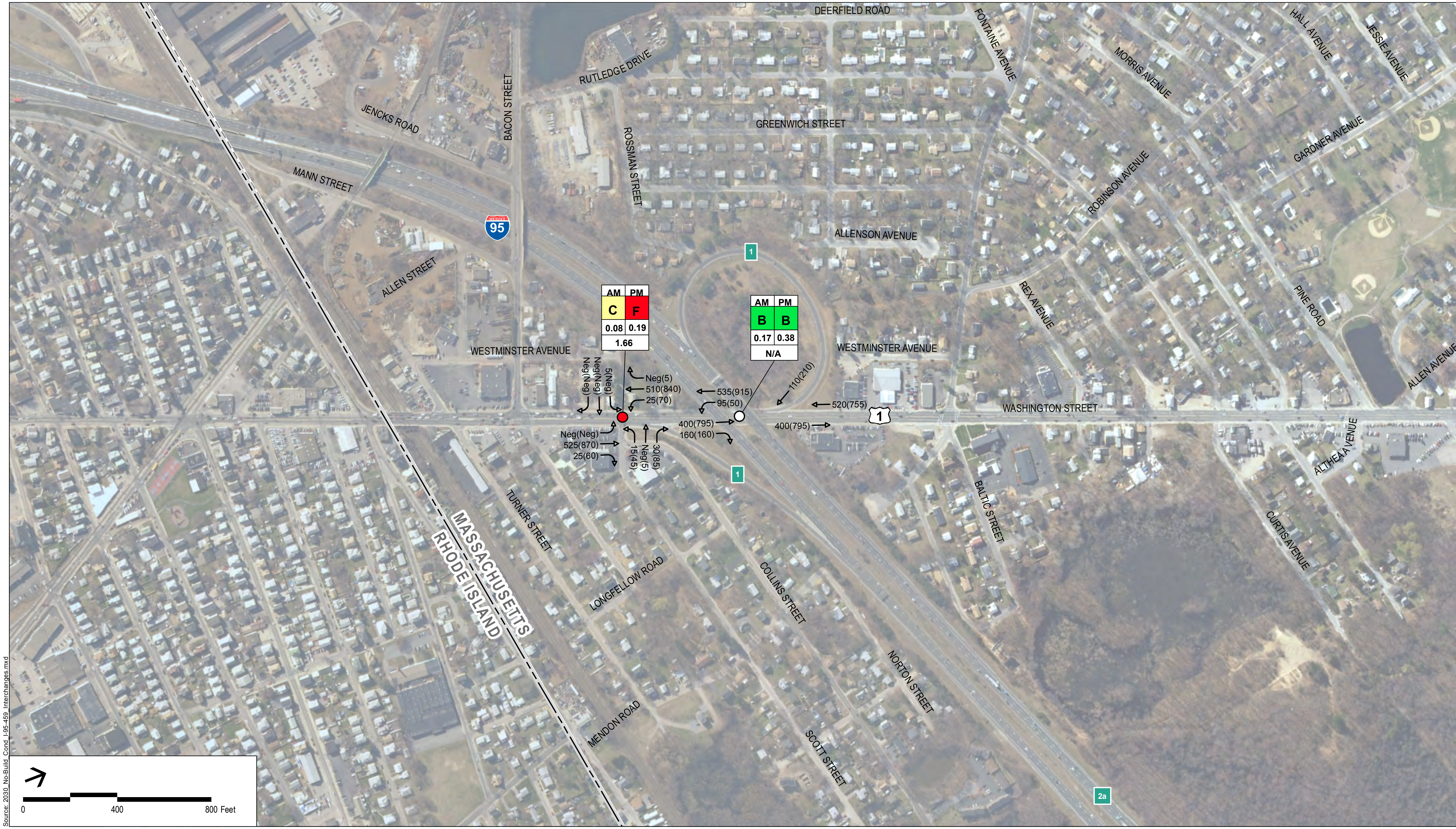


Vanasse Hangen Brustlin, Inc.

Figure 3-11

2030 Baseline Conditions
Volumes and Levels of Service (AM/PM)
I-495 Corridor - Sheet 2 of 2

I-95 South Corridor Study



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

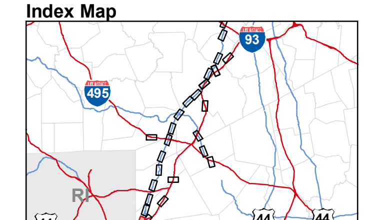
Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



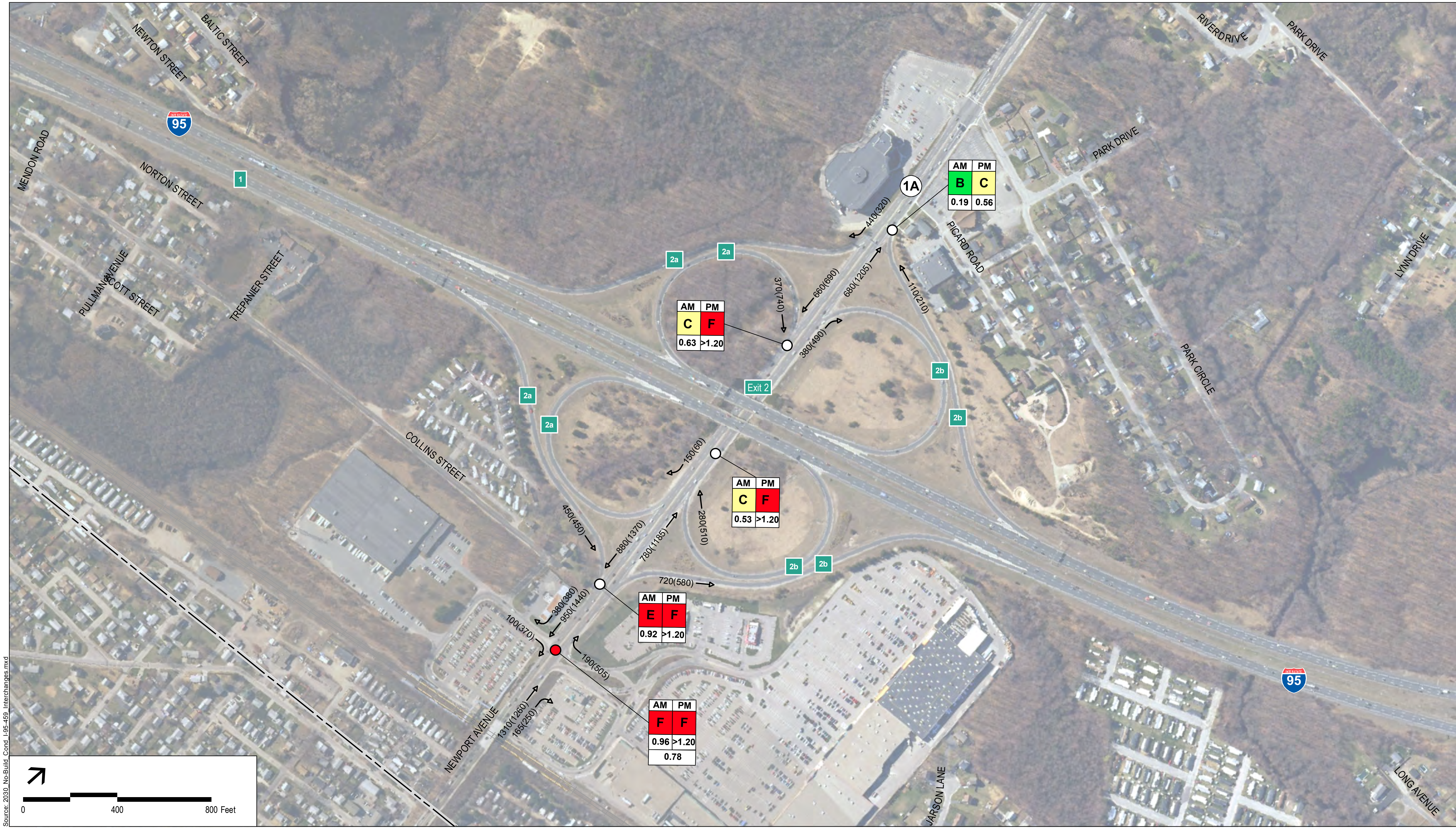
Vanasse Hangen Brustlin, Inc.

Figure 3-12

2030 Baseline Conditions
I-95 Interchange 1
Route 1 - Attleboro

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



Source: 2030_No-Build_Cond_I-95-459_Interchanges.mxd

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

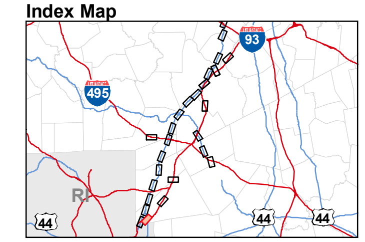


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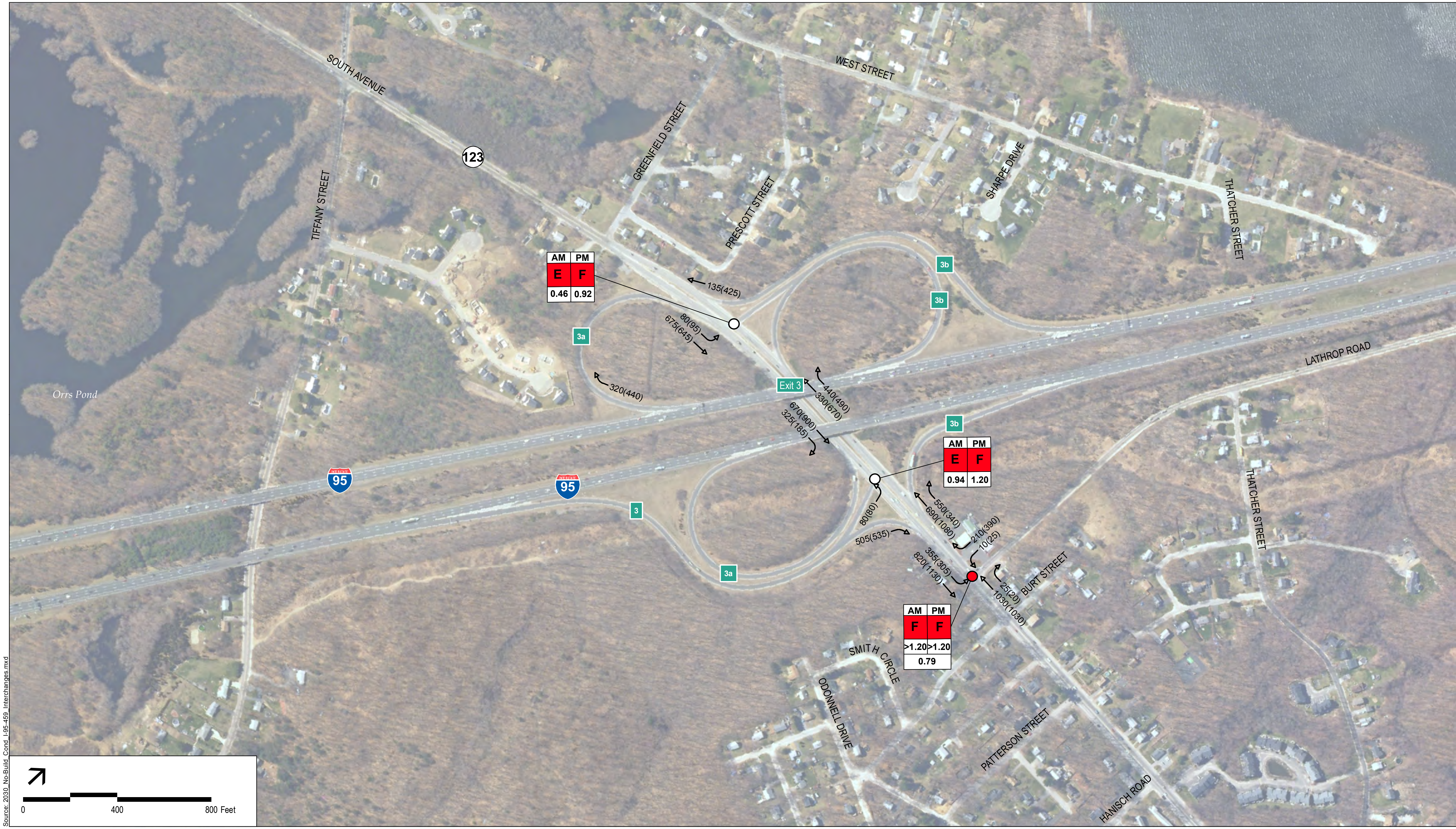
Figure 3-13

2030 Baseline Conditions
I-95 Interchange 2
Route 1A - Attleboro

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



Source: 2030_No-Build_Cond_I-95-459_Interchanges.mxd

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Legend

Intersection Level of Service

AM PM A F — Level of Service; x.xx x.xx — Volume/Capacity Ratio; x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

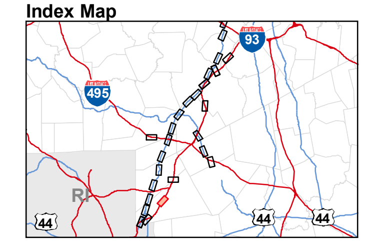
Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



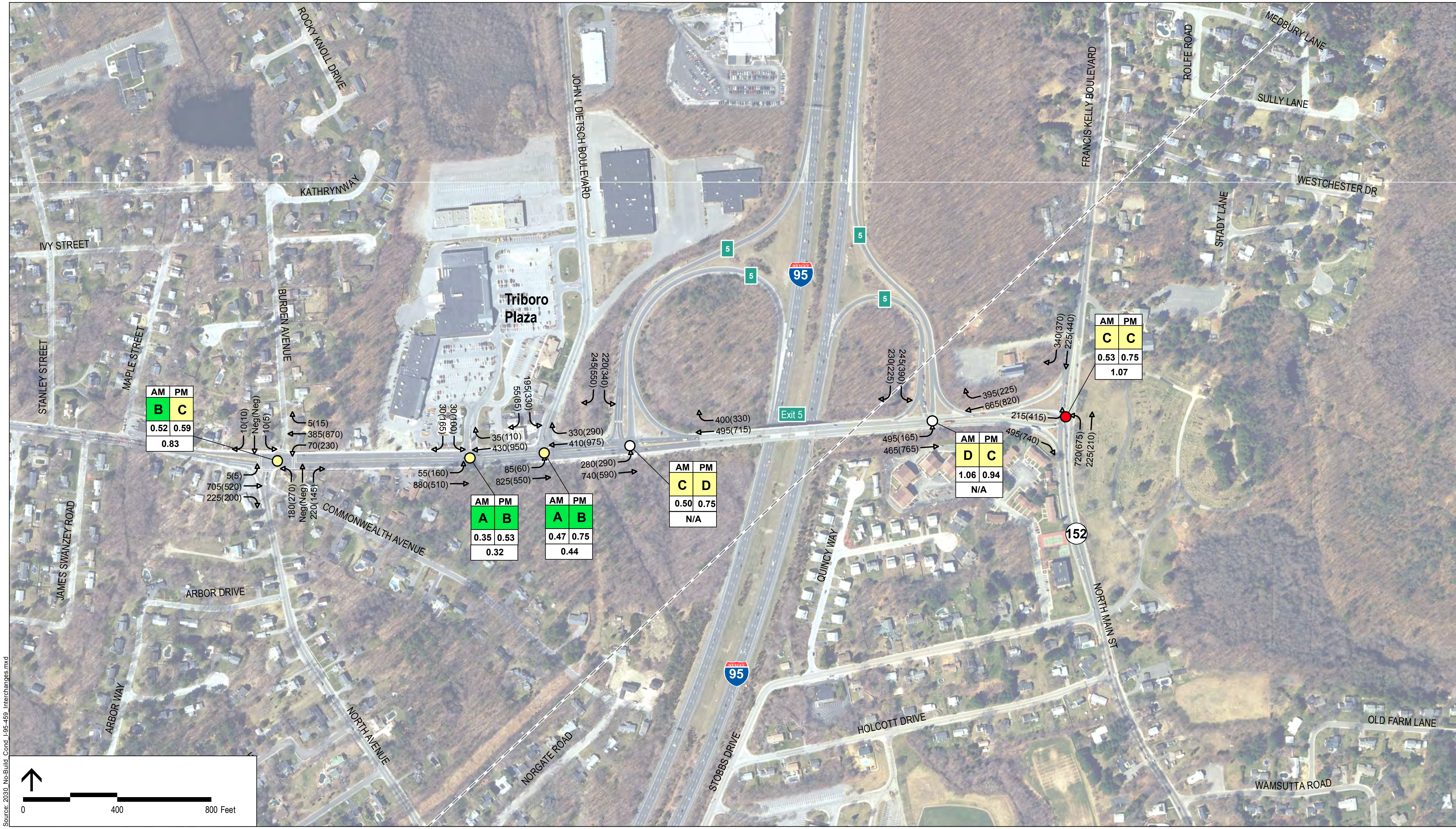
Vanasse Hangen Brustlin, Inc.

Figure 3-14

2030 Baseline Conditions
I-95 Interchange 3
Route 123 - Attleboro

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



massDOT
Moving Massachusetts Forward
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

Level of Service

Volume/Capacity Ratio

Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

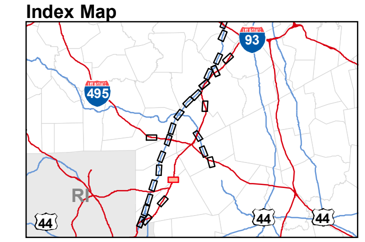
Yes

No

N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



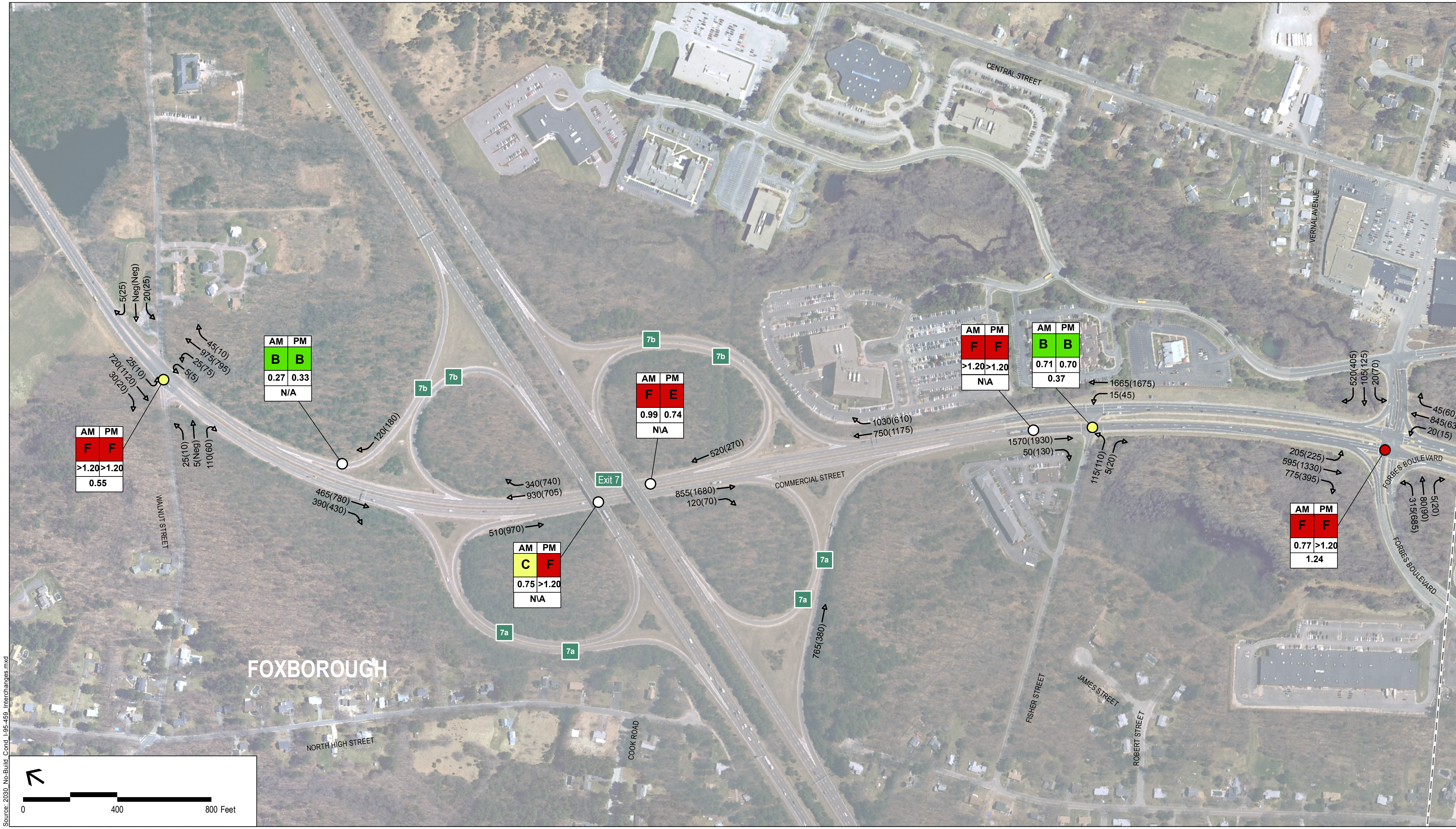
Vanasse Hangen Brustlin, Inc.

Figure 3-15

2030 Baseline Conditions
I-95 Interchange 5
Toner Boulevard - North Attleborough

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

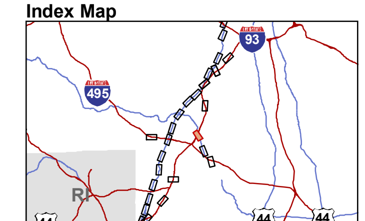
Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



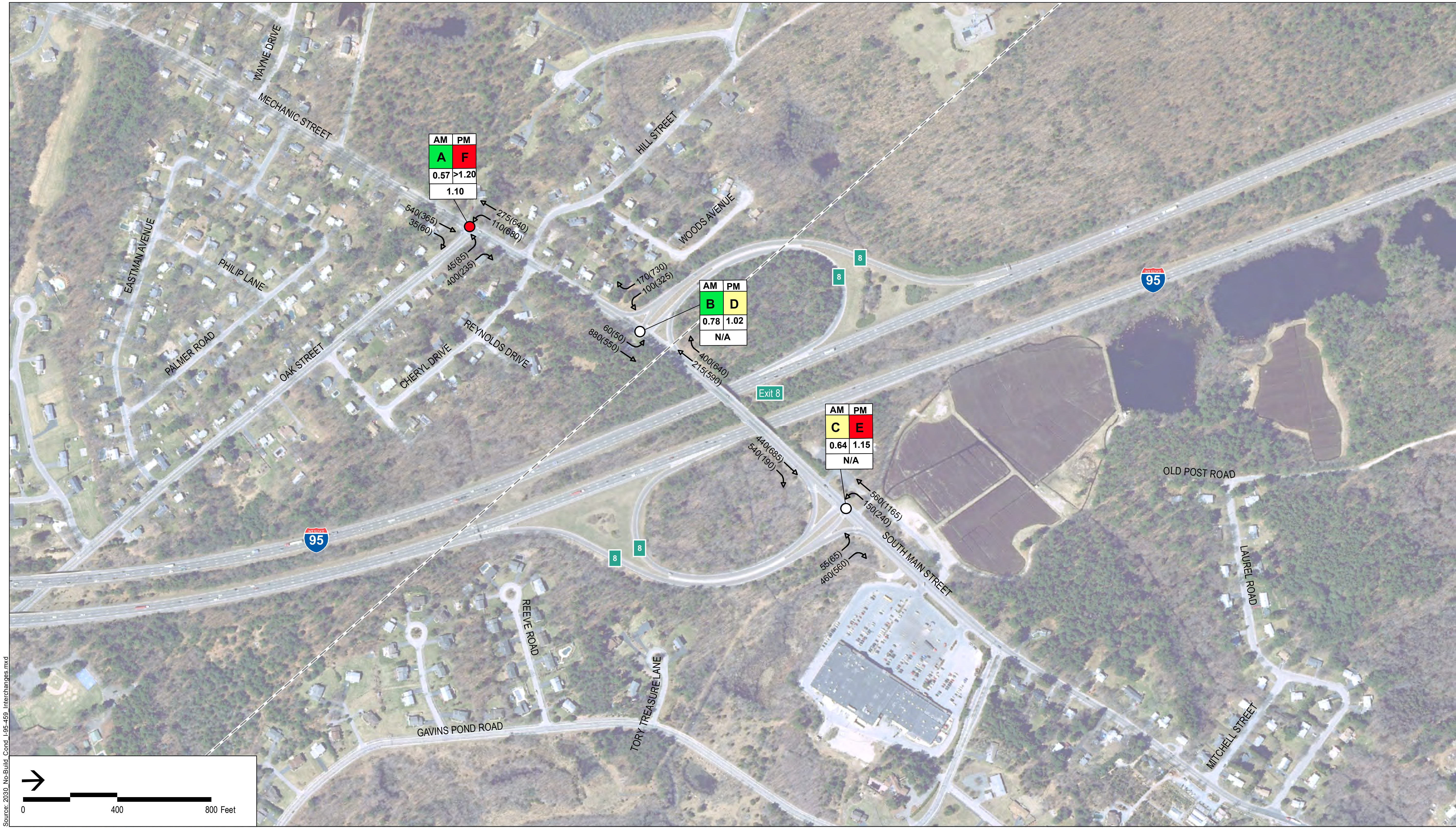
Vanasse Hangen Brustlin, Inc.

Figure 3-16

2030 Baseline Conditions
I-95 Interchange 7
Route 140 - Mansfield

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

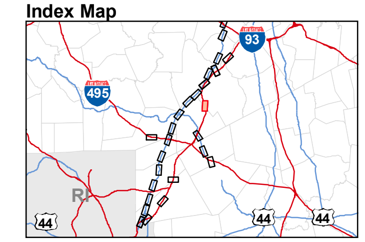
Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



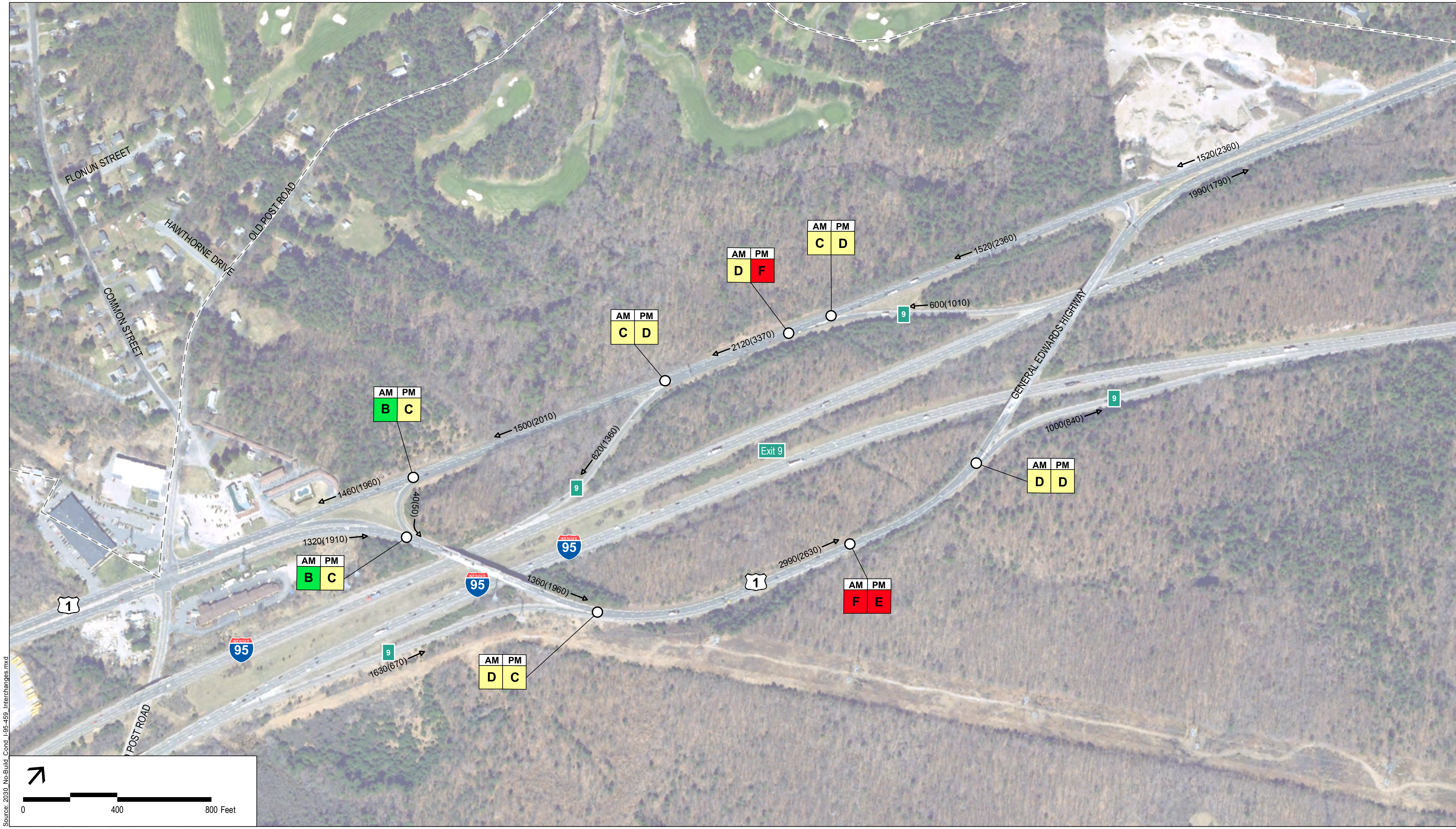
Vanasse Hangen Brustlin, Inc.

Figure 3-17

2030 Baseline Conditions
I-95 Interchange 8
Mechanic St. / South Main St. - Sharon

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

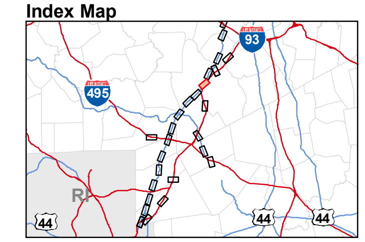
Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-18

2030 Baseline Conditions
I-95 Interchange 9
Route 1 - Sharon

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study

Source: 2030_No-Build_Cond_I-95-459_Interchanges.mxd

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

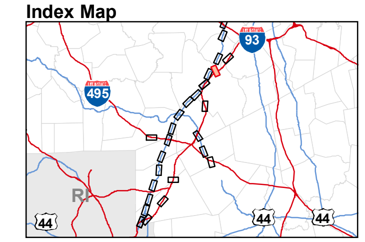
A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersections
Exceeds MHD Average Crash Rate?
Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



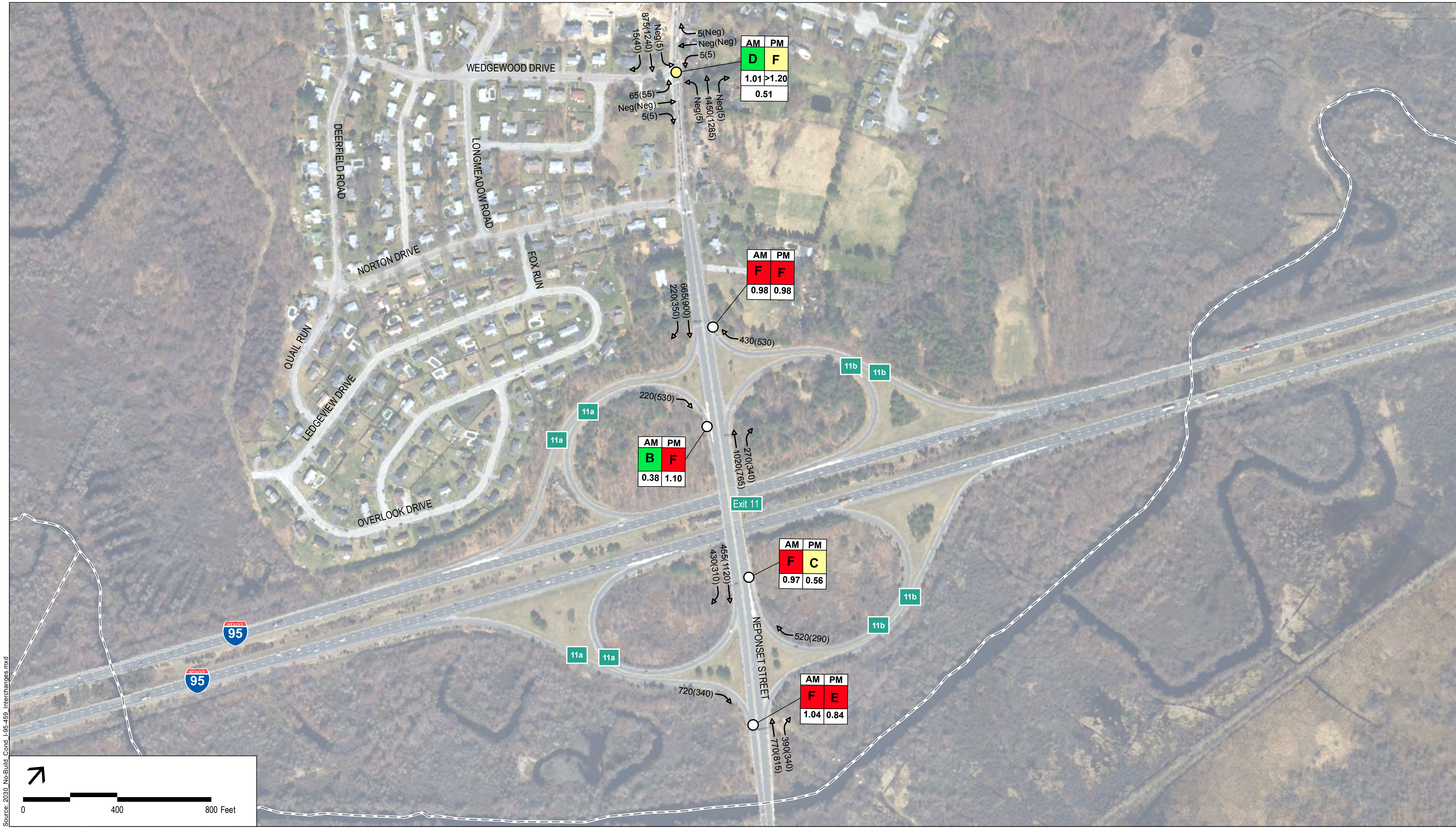
Vanasse Hangen Brustlin, Inc.

Figure 3-19

2030 Baseline Conditions
I-95 Interchange 10
Coney Street - Walpole

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study



Legend

Intersection Level of Service

AM PM
A F — Level of Service
x.xx x.xx — Volume/Capacity Ratio
x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

Yes

No

N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

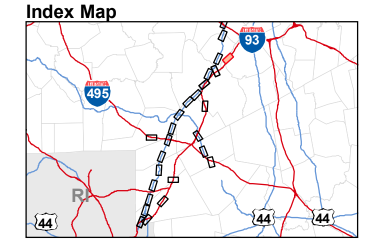


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Figure 3-20

2030 Baseline Conditions
I-95 Interchange 11
Neponset Street - Norwood

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study

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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

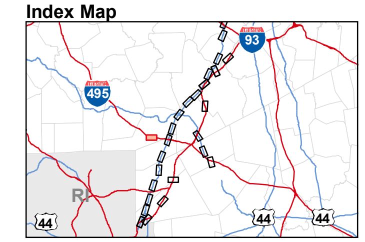
Intersections

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-21

2030 Baseline Conditions
I-495 Interchange 15
Route 1A - Wrentham

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

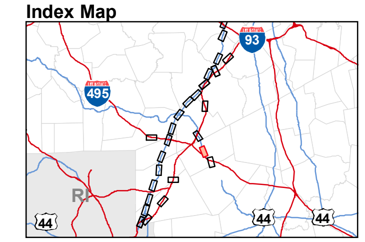

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Figure 3-22

2030 Baseline Conditions
I-495 Interchange 12
Route 140 - Mansfield

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM PM A F — Level of Service; x.xx x.xx — Volume/Capacity Ratio; x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

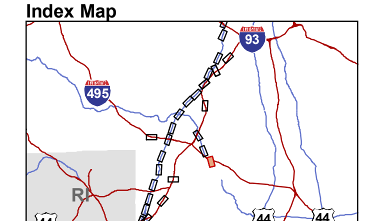
Intersections

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-23

2030 Baseline Conditions
I-495 Interchange 11
Route 140 - Mansfield

Volumes and Levels of Service (AM/PM)

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

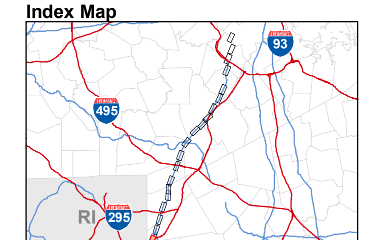
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-24

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 1 of 20

I-95 South Corridor Study

Source: \\Mawatr\ts\10527.00\GIS\project\Existing_Conditions\Intersections_Route-1_Sheet-2.mxd

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Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Index Map

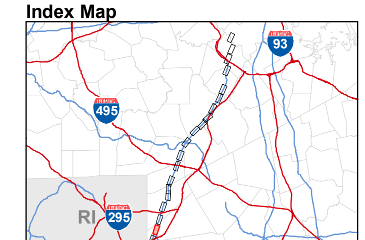

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Figure 3-25

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 2 of 20

I-95 South Corridor Study

Source: \\Mawan\ts\10527.00\GIS\project\2030_No_Build_Conditions\2030_No-Build_Cond_Route-1_Intersections.mxd

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

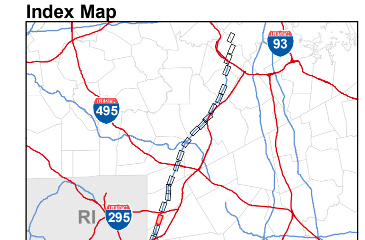

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Figure 3-26

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 3 of 20

I-95 South Corridor Study

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

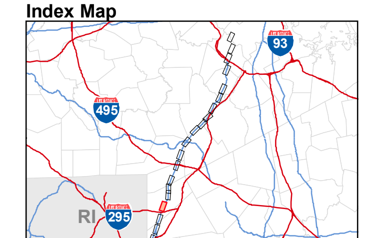

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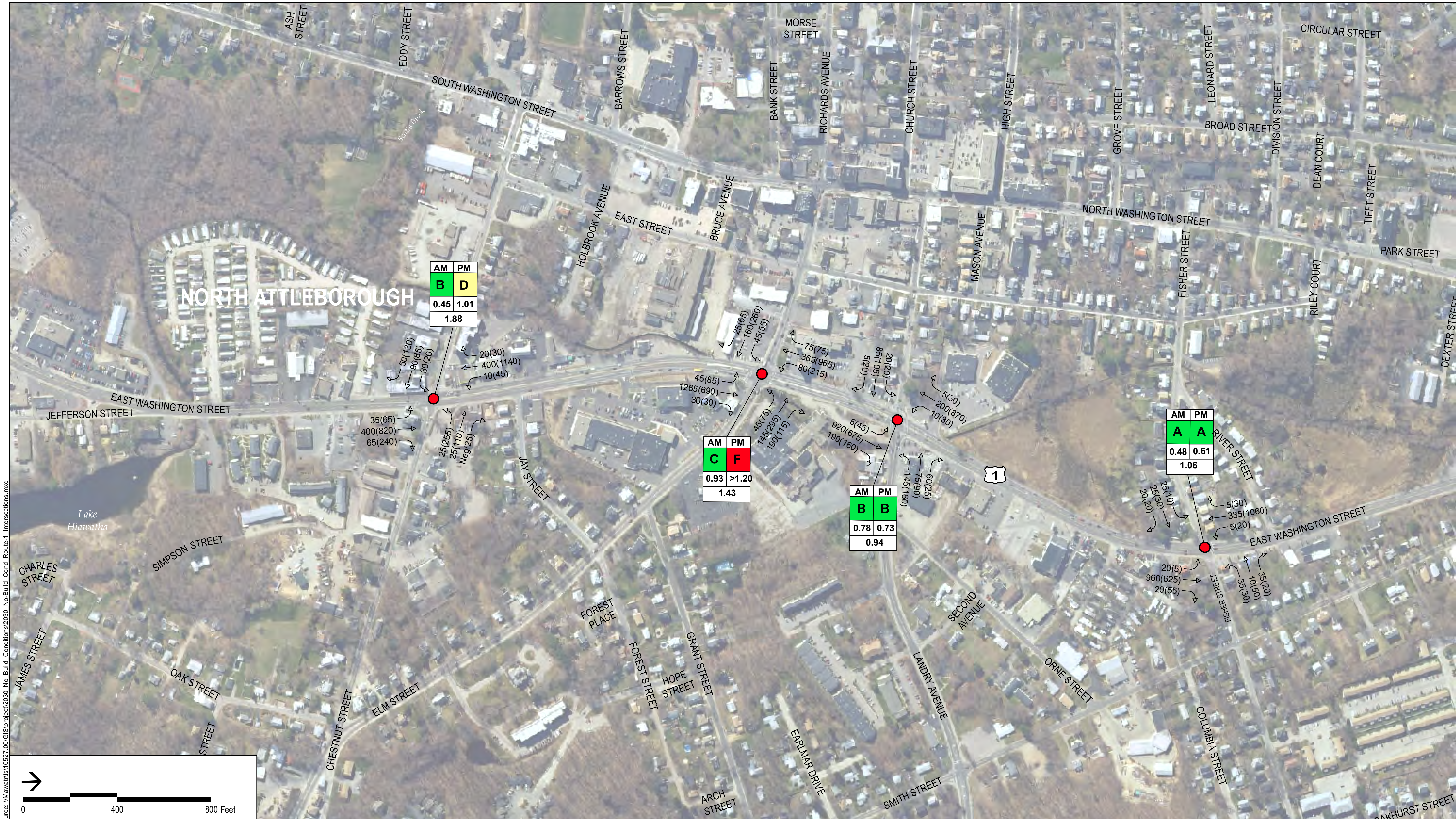
Figure 3-27

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 4 of 20

I-95 South Corridor Study



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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

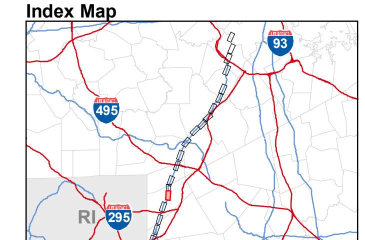
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Index Map



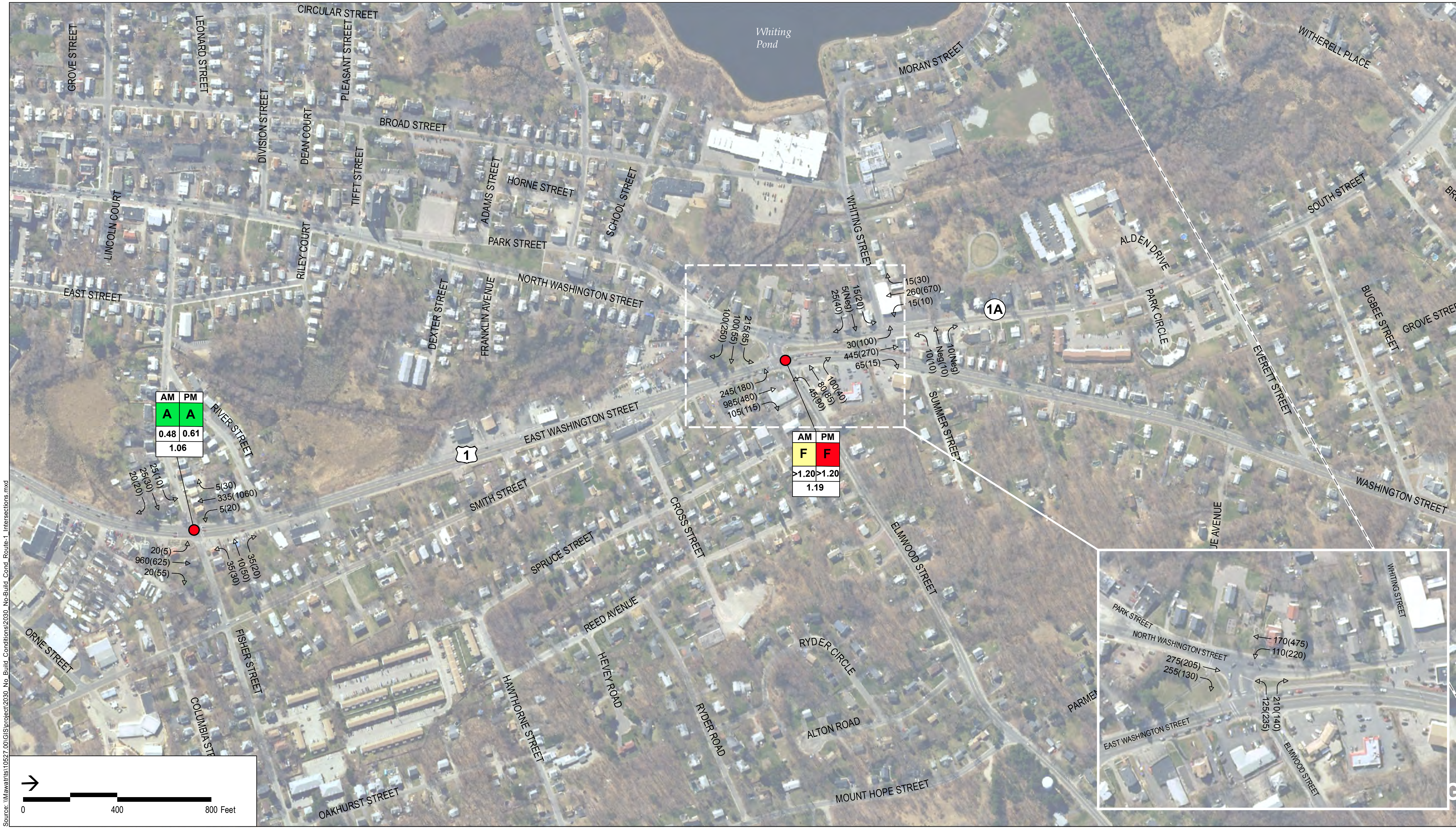
Vanasse Hangen Brustlin, Inc.

Figure 3-28

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 5 of 20

I-95 South Corridor Study



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Index Map

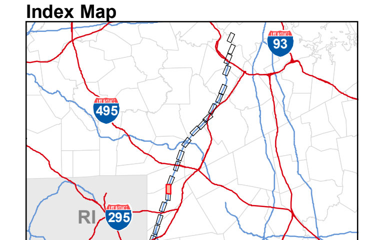


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Figure 3-29

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 6 of 20

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

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Figure 3-30

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 7 of 20

I-95 South Corridor Study

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Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

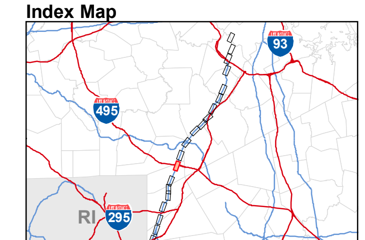
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-31

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 8 of 20

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

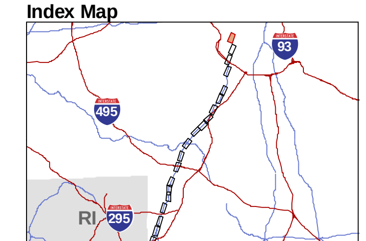
Intersection Safety Level

Exceeds MHD Average Crash Rate?

Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



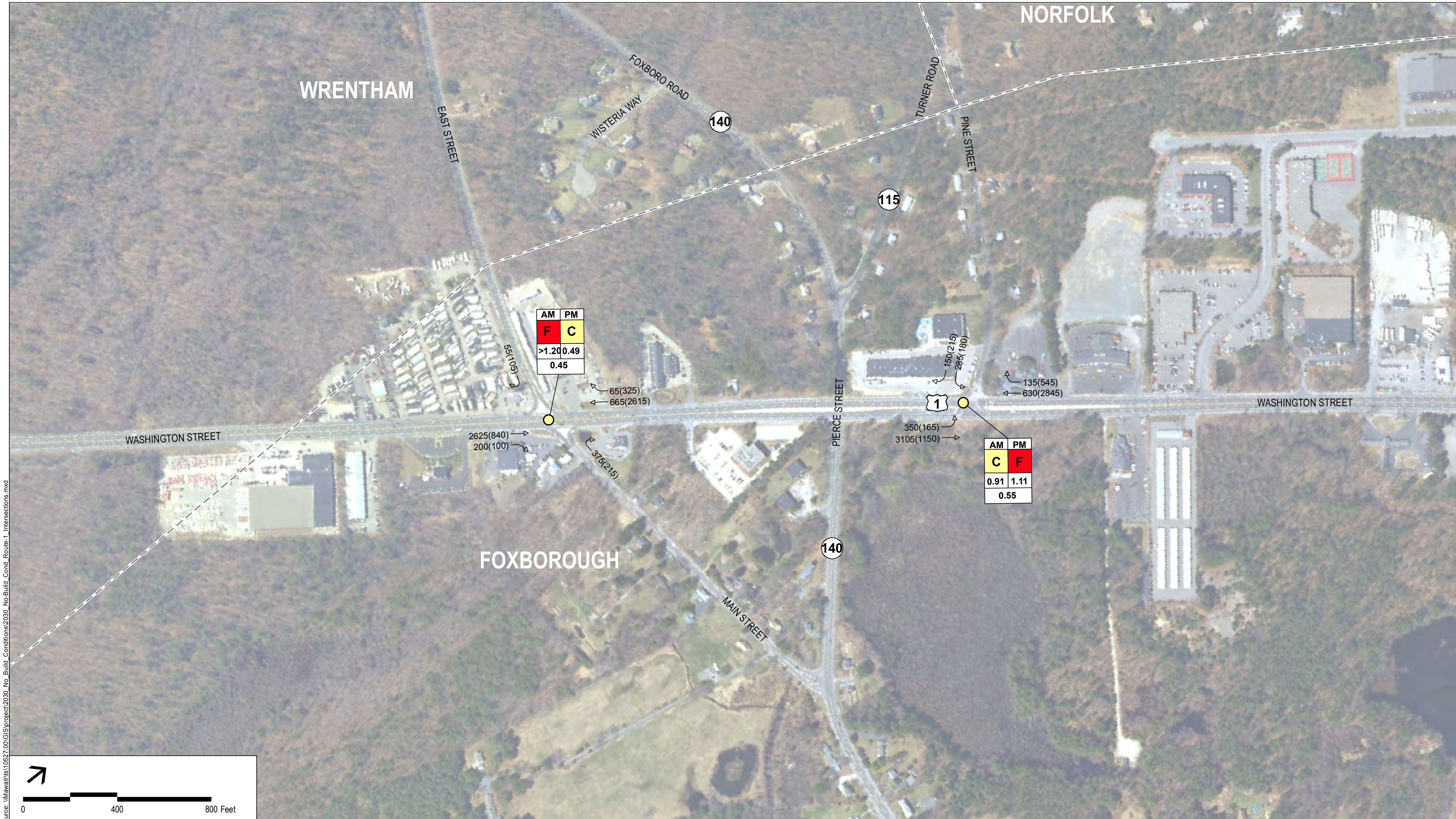
Vanasse Hangen Brustlin, Inc.

Figure 3-32

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 9 of 20

I-95 South Corridor Study



massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

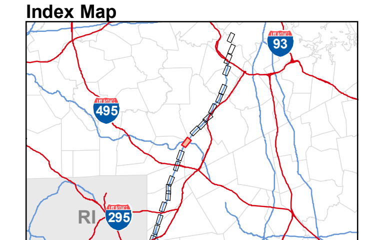
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-33

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

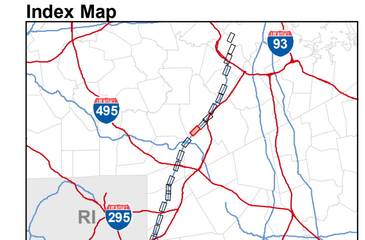
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-34

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

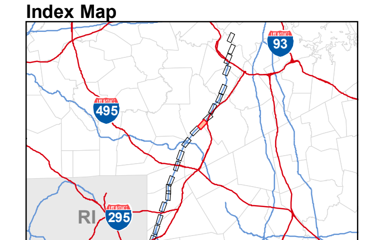
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-35

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 12 of 20

I-95 South Corridor Study

Source: \\Mawatr\ts\10527.00\GIS\project\2030_No_Build_Conditions\2030_No-Build_Cond_Route-1_Intersections.mxd

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

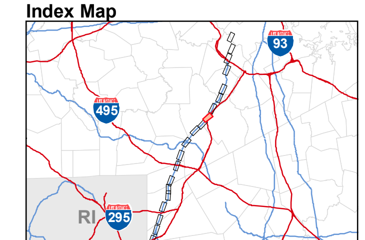
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-36

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

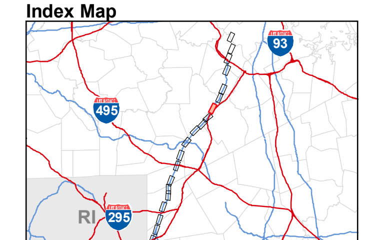
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-37

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

massDOT Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM PM A F — Level of Service; x.xx x.xx — Volume/Capacity Ratio; x.xx — Crash Rate

A/B C/D E/F

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map

Vanasse Hangen Brustlin, Inc.

Figure 3-38

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

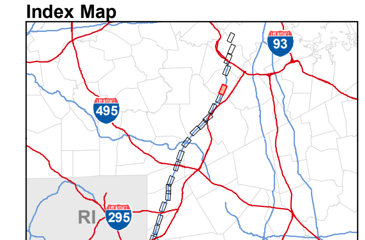
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-39

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 16 of 20

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

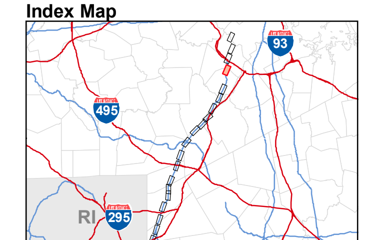
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



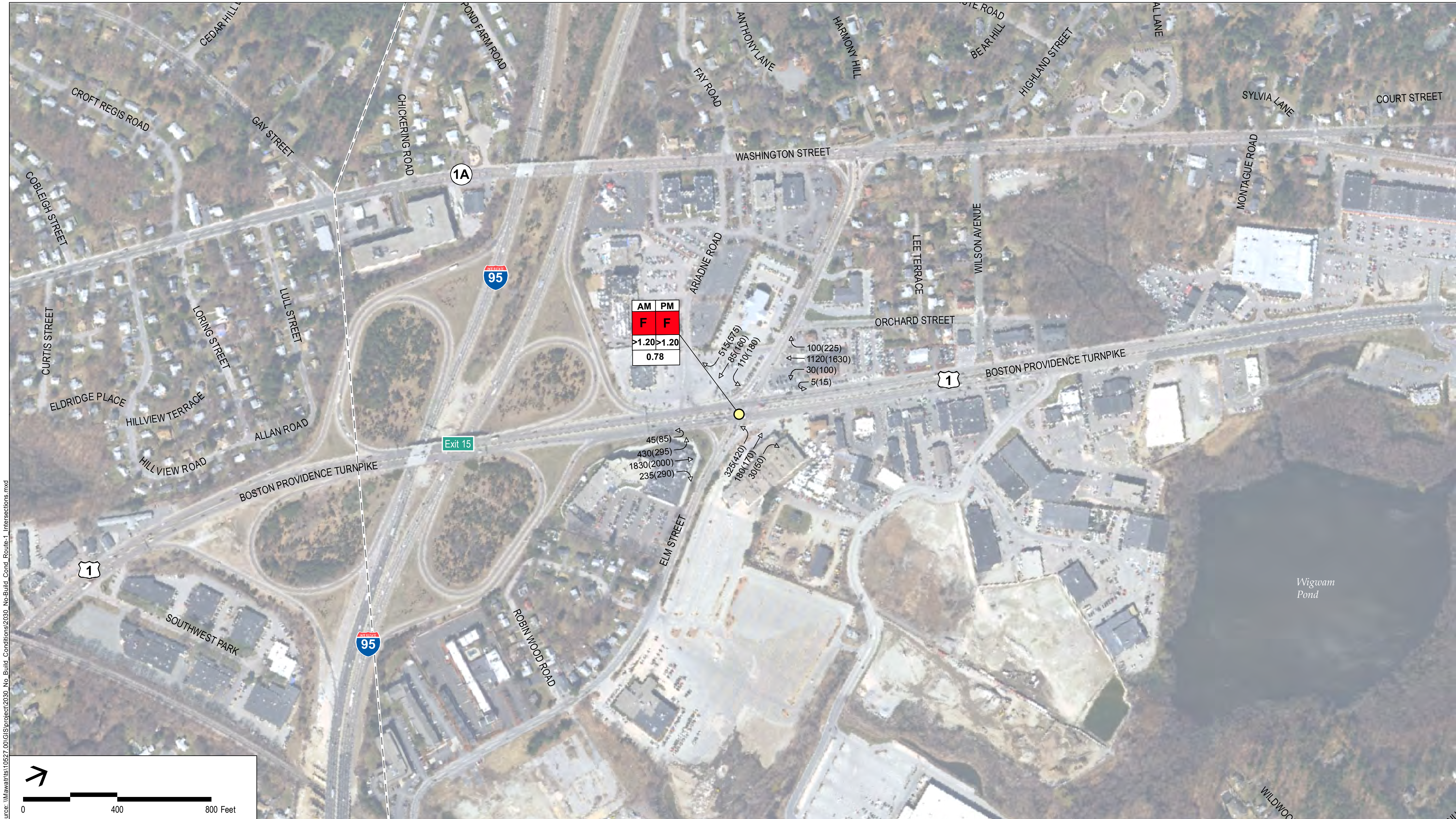
Vanasse Hangen Brustlin, Inc.

Figure 3-40

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 17 of 20

I-95 South Corridor Study



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massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

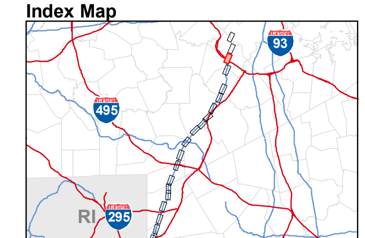
A/B C/D E/F
Level of Service
Volume/Capacity Ratio
Crash Rate

Traffic Volumes
XX - AM
(XX) - PM
Neg - Negligible

Intersection Safety Level
Exceeds MHD Average Crash Rate?
Yes
No
N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-41

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

Source: \\Mawatr\ts\10527.00\GIS\project\2030_No_Build_Conditions\2030_No-Build_Cond_Route-1_Intersections.mxd

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

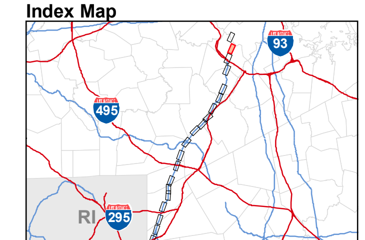
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-42

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

Sheet 19 of 20

I-95 South Corridor Study

massDOT
Massachusetts Department of Transportation

Legend

Intersection Level of Service

AM	PM
A	F
x.xx	x.xx
x.xx	

A/B C/D E/F

Level of Service

Volume/Capacity Ratio

Crash Rate

Traffic Volumes

XX - AM
(XX) - PM
Neg - Negligible

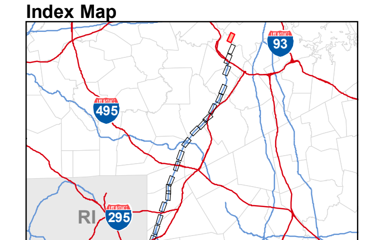
Intersection Safety Level

Exceeds MHD Average Crash Rate?

- Yes
- No
- N/A

Note: Aerial images are from 2005.
Land uses may have changed since photos were taken.

Index Map



Vanasse Hangen Brustlin, Inc.

Figure 3-43

2030 Baseline Conditions - Route 1
Volumes and Levels of Service (AM/PM)

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I-95 South Corridor Study

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3.5.2 I-95/I-495 Intersection Improvements

At the time of this study's preparation, the following improvement projects were identified through the local outreach discussions within the I-95 study area. It should be noted that several of these projects were completed by the conclusion of this effort and are noted below.

I-95 Exit 5 Intersection Improvements

Two of the study area intersections at this interchange were planned for improvements as described in detail below:

- Toner Boulevard at I-95 northbound ramps – It was assumed that a fully actuated traffic signal will be constructed here.
- Toner Boulevard at Route 152 – Provide dual northbound left-turn lanes, modify intersection geometry, and optimize signal timings

These improvement measures were recently completed and have been included in the 2030 Baseline traffic analysis.

I-95 Exit 8 Intersection Improvements

Mitigation has been committed to at several intersections along Mechanic Street and South Main Street as part of the nearby Sharon Commons mixed-use development. These mitigation measures are described in detail below:

- "South Main Street" in Sharon at I-95 northbound ramps – It was assumed that a fully actuated traffic signal will be constructed here although no formal design has been completed to date.
- "South Main Street" in Sharon at I-95 southbound ramps – It was assumed that a fully actuated traffic signal will be constructed here although no formal design has been completed to date.

These improvement measures have been included in the 2030 Baseline traffic analysis along with the specific impacts to the area roadway network associated with the Sharon Commons project.

I-495 Exit 11 Intersection Improvements

Improvements have been identified at two intersections along Route 140/South Main Street. These improvement measures are described in detail below:

- Route 140/South Main Street at I-495 northbound ramps – Install a fully actuated traffic signal; widen Route 140/South Main Street to provide an exclusive through lane and a shared through/right-turn lane northbound and left-turn lane and two through lanes southbound; and widen the I-495 off-ramp to provide a left-turn lane and two channelized right-turn lanes.
- Route 140/South Main Street at I-495 southbound ramps – Install a fully actuated traffic signal; and widen Route 140/South Main Street to provide a left-turn lane, a shared left-turn/through lane and a through lane northbound and through lane and channelized right-turn lane southbound.

These improvement measures have been undergoing both local and Federal review and have been included in the 2030 Baseline traffic analysis.

3.5.3 Route 1 Intersection Improvements

The following improvement projects have been identified along the Route 1 corridor within the study area.

Patriot Place Route 1 Intersection Improvements

As part of the Patriot Place development described above, mitigation has been committed to at several intersections along Route 1. These mitigation measures generally include signal timing adjustments and some geometric modifications as described in detail below:

- #91 Route 1 at Old Post Road – Optimize signal timings
- #92 Route 1 at Pine Street (Walpole) – Optimize signal timings
- #93 Route 1 at Water Street/North Street – Optimize signal timings
- #94 Route 1 at Patriot Place/Rodman Ford driveway – Optimize signal timings
- #95 Route 1 at Pine Street (Foxborough) – Widen the intersection to provide an additional northbound and southbound travel lane and optimize signal timings
- #97 Route 1 at Thurston Street – Widen the intersection to provide an additional northbound and southbound travel lane and optimize signal timings

These improvement measures have been included in the 2030 Baseline traffic analysis.

Other Route 1 Intersection Improvements

Improvements to several Route 1 study area intersections have been committed to as part of mitigation for proposed developments or to update existing known deficiencies. These improvement measures are described in detail below:

- #81 Providence Highway at Eastern Avenue – Widen Providence Highway southbound to provide an exclusive left-turn lane, two through lanes, and a short channelized right-turn lane; re-stripe Eastern Avenue eastbound approach as a shard left-turn/through lane and a right-turn lane; and upgrade existing signal equipment to a fully actuated and coordinated system.

- #82 Providence Highway at Elm Street – Widen Elm Street approaches to include two left-turn lanes, a through lane, and a channelized right-turn lane eastbound and a left-turn lane, a shared left-turn/through lane, and a right-turn lane; and upgrade existing signal equipment to a fully actuated and coordinated system.
- #85 Route 1 at Dean Street – Widen Route 1 to provide three through travel lanes northbound and southbound that extend to the Route 1 ramps; and widen Dean Street to provide two left-turn lanes, one through lane and a channelized right-turn lane eastbound and a left-turn lane, a through lane and a shared through/right-turn lane westbound.
- #85-1 Dean Street at the Route 1 southbound ramp – Install a fully actuated traffic signal; widen Dean Street to provide two general purpose lanes on both the eastbound and westbound approaches; widen the Route 1 southbound ramp to provide a left-turn lane, a shared left-turn/through lane, and a right-turn lane.
- #85-2 Dean Street at the Route 1 northbound ramp – Install a fully actuated traffic signal; widen Dean Street to provide one through/right-turn lane eastbound and one left-turn/through lane and two through lanes westbound; widen the Route 1 northbound ramp to provide a left-turn lane and a shared left- and right-turn lane.
- #89 Route 1 at Coney Street – Upgrade existing signal equipment to include a Coney Street westbound left-turn lead phase and an exclusive pedestrian phase upon actuation.

Improvements to the intersection of Providence Highway at Washington Street (Route 1) have been considered by the town and through private developers as part of traffic impact efforts, however no formal design has been proposed and/or completed to date. Therefore, improvements to this location have not been included in the 2030 Baseline traffic analysis.

3.6 2030 Future Traffic Operations

The next step in the study process was to evaluate the projected future operations of the study area roadway system and compare them to the existing conditions. This analysis provides a technical assessment of the operational qualities of the freeway segments, ramps, weaving segments, and intersections using the procedures outlined in the 2000 Highway Capacity Manual (HCM)[8]. The traffic analysis was conducted using the 2030 Baseline weekday morning and weekday evening peak hour traffic volumes and the future geometric design conditions as they currently are anticipated to exist along the study area roadways. Any roadway improvements from the existing conditions that have been incorporated into the 2030 Baseline condition were described above. The relationship between the supply and demand on a roadway is fundamental in evaluating how well a transportation facility fulfills its objective to safely and efficiently accommodate the travelling public. The LOS results are show in Figures 3-5 through 3-43.

8 Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2000.

3.6.1 Basic Freeway Segment Operations

The capacity of basic freeway segments was analyzed using procedures outlined in Chapter 23, Basic Freeway Segments, of the HCM. The results of the basic freeway segment analysis for I-95 and I-495 under morning and evening peak hour conditions are summarized in Table 3-4 and Table 3-5, respectively. The results are also presented graphically in the 2030 Baseline Condition figures (Figures 3-5 through 3-10) for the I-95 and I-495 corridors. Capacity analysis worksheets for basic freeway segments are included in the Appendix. Note that the interchange of I-93/I-95 is currently undergoing its own separate evaluation as part of another MassDOT study. Key results include:

I-95 Northbound - During the morning peak hour, four of the 13 segments will continue to operate under congested conditions (LOS E/F) under the 2030 Baseline Conditions. Five additional segments are projected to degrade to LOS E/F in the 2030 Baseline Conditions from acceptable LOS D in the 2008 Existing Conditions. These nine segments are generally located from the I-295 (Exit 4) on-ramp to I-93/Route 128 (Exit 12) off-ramp. During the evening peak hour, the northbound direction of I-95 is projected to continue to operate at acceptable levels within the study area. All segments operate at LOS D or better during the 2030 Baseline Conditions.

I-95 Southbound - During the morning peak hour, all segments of I-95 southbound within the study area are projected to continue to operate at LOS C or better. During the evening peak hour, four of the 13 segments of I-95 southbound continue to operate under congested conditions (LOS E/F). Five additional segments are projected to degrade to LOS E/F in the 2030 Baseline Conditions from acceptable LOS D in the 2008 Existing Conditions. These nine segments are generally located from the I-93/Route 128 (Exit 12) on-ramp to the I-295 (Exit 4) off-ramp.

I-495 Northbound - During both the morning and evening peak hours, all segments of I-495 northbound within the study area are projected to continue to operate at LOS D or better.

I-495 Southbound -- During both the morning and evening peak hours, all segments of I-495 southbound within the study area are projected to continue to operate at LOS D or better.

Table 3-4 I-95 Freeway Segment Capacity Analyses Summary

I-95 Northbound

Freeway Segment Description		2008 Existing Conditions						2030 Baseline Conditions					
		Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
From	To	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
RI State Line	Exit 1	3,600	20.7	C	3,300	19.0	C	3,920	22.6	C	3,590	20.7	C
Exit 1	Exit 2	3,900	22.4	C	3,500	20.2	C	4,240	24.4	C	3,820	22.0	C
Exit 2	Exit 3	4,100	23.6	C	3,250	18.7	C	4,380	25.3	C	3,500	20.2	C
Exit 3	Exit 4	4,300	24.7	C	3,150	18.0	B	4,590	26.5	D	3,410	19.5	C
Exit 4	Exit 5	5,650	34.8	D	4,150	23.7	C	6,120	40.7	E	4,550	26.1	D
Exit 5	Exit 6	6,050	40.6	E	4,000	23.0	C	6,540	37.7	F	4,390	25.3	C
Exit 6	Exit 7	6,050	39.3	E	3,400	19.3	C	6,520	37.0	F	3,760	21.3	C
Exit 7	Exit 8	5,850	37.8	E	3,350	19.3	C	6,400	36.9	F	3,800	21.9	C
Exit 8	Exit 9	6,000	39.8	E	3,150	18.1	C	6,600	38.0	F	3,630	20.9	C
Exit 9	Exit 10	5,150	30.7	D	3,050	17.6	B	5,970	39.4	E	3,800	21.9	C
Exit 10	Exit 11	5,550	34.1	D	3,400	19.5	C	6,510	37.3	F	4,250	24.4	C
Exit 11	Slip Ramp [4]	4,950	29.1	D	3,250	18.7	C	6,150	42.1	E	4,270	24.6	C
Slip Ramp [4]	Exit 12	4,950	29.1	D	3,250	18.7	C	5,910	38.6	E	4,100	23.6	C

I-95 Southbound

Freeway Segment Description		2008 Existing Conditions						2030 Baseline Conditions					
		Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
From	To	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 12	Slip Ramp	2,950	17.0	B	5,200	31.1	D	3,540	20.4	C	6,170	42.4	E
Slip Ramp	Exit 11	3,050	17.6	B	6,100	41.3	E	3,700	21.3	C	7,310	42.1	F
Exit 11	Exit 10	3,050	17.5	B	6,100	40.9	E	3,540	20.3	C	6,940	39.8	F
Exit 10	Exit 9	2,650	15.3	B	5,500	33.9	D	3,050	17.6	B	6,180	42.6	E
Exit 9	Exit 8	2,800	16.1	B	5,900	38.4	E	3,070	17.7	B	6,530	37.6	F
Exit 8	Exit 7	3,000	17.3	B	5,600	34.9	D	3,210	18.5	C	6,120	41.6	E
Exit 7	Exit 6	3,100	17.6	B	5,650	34.5	D	3,320	18.8	C	6,170	41.0	E
Exit 6	Exit 5	3,700	21.3	C	5,900	38.4	E	3,960	22.8	C	6,420	37.0	F
Exit 5	Exit 4	3,800	21.7	C	5,650	34.8	D	4,070	23.2	C	6,130	40.9	E
Exit 4	Exit 3	2,900	16.6	B	3,800	21.8	C	3,060	17.5	B	4,060	23.3	C
Exit 3	Exit 2	2,950	17.0	B	3,550	20.4	C	3,140	18.1	C	3,810	21.9	C
Exit 2	Exit 1	3,250	18.7	C	3,400	19.6	C	3,480	20.0	C	3,670	21.1	C
Exit 1	RI State Line	3,150	18.1	C	3,200	18.4	C	3,370	19.4	C	3,460	19.9	C

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).
4 I-95 Northbound Slip Ramp does not currently exist, but will be constructed by 2030.

Table 3-5 I-495 Freeway Segment Capacity Analyses Summary

I-495 Northbound

Freeway Segment Description		2008 Existing Conditions						2030 Baseline Conditions					
		Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
From	To	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 10	Exit 11	3,600	20.7	C	3,600	20.7	C	4,510	26.1	D	4,490	26.0	C
Exit 11	Exit 12	3,000	17.3	B	3,200	18.4	C	3,750	21.6	C	3,970	22.9	C
Exit 12	Exit 13	3,900	22.4	C	3,900	22.4	C	4,930	29.0	D	4,890	28.7	D
Exit 13	Exit 14	3,600	20.7	C	4,050	23.3	C	4,510	26.1	D	4,930	29.0	D
Exit 14	Exit 15	3,400	19.6	C	4,000	23.0	C	4,120	23.7	C	4,900	28.7	D
Exit 15	Exit 16	3,400	19.6	C	3,900	22.4	C	4,010	23.1	C	4,640	26.9	D

I-495 Southbound

Freeway Segment Description		2008 Existing Conditions						2030 Baseline Conditions					
		Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
From	To	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 16	Exit 15	3,600	20.7	C	3,600	20.7	C	4,290	24.7	C	4,230	24.4	C
Exit 15	Exit 14	3,650	21.0	C	3,700	21.3	C	4,500	26.0	C	4,490	26.0	C
Exit 14	Exit 13	3,800	21.9	C	3,900	22.4	C	4,650	27.0	D	4,930	29.0	D
Exit 13	Exit 12	3,500	20.2	C	4,100	23.6	C	4,450	25.7	C	5,270	31.7	D
Exit 12	Exit 11	3,000	17.3	B	3,100	17.8	B	3,790	21.8	C	3,940	22.7	C
Exit 11	Exit 10	3,300	19.0	C	3,700	21.3	C	4,280	24.7	C	4,890	28.7	D

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).

3.6.2 Ramp Operations

The analysis of merge and diverge operations at ramps is based on procedures presented in Chapter 25, Ramps and Ramp Junctions, of the HCM. The results of the merge and diverge analyses for I-95 are presented in Table 3-6 and Table 3-7, respectively. The results of the merge and diverge analyses for I-495 are presented in Table 3-8 and Table 3-9, respectively. The results are also presented graphically in the future conditions figures for the I-95 and I-495 corridors (Figures 3-5 through 3-10). Capacity analysis worksheets for ramp merges and diverges are included in the Appendix. Key results of the merge analyses include:

I-95 Northbound - During the morning peak hour, eight of the 16 on-ramps to I-95 northbound continue to operate under congested conditions (LOS E/F) during the 2030 Baseline Conditions. Three additional ramps are projected to degrade to LOS E/F in 2030 from acceptable LOS D in the 2008 Existing Conditions. Poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream and downstream off-ramps. The remaining five I-95 northbound on-ramps are projected to operate at acceptable LOS D or better during the morning peak hour. All I-95 northbound on-ramps operate at LOS D or better during the evening peak hour, with the exception of the I-295 on-ramp (Exit 4). This ramp is projected to degrade from LOS E in the 2008 Existing Conditions to LOS F in the 2030 Baseline Conditions.

I-95 Southbound - All I-95 southbound on-ramps are projected to continue to operate at LOS C or better during the morning peak hour in the 2030 Baseline Conditions. During the evening peak hour, eight of the 14 on-ramps to I-95 southbound are projected to continue to operate under congested conditions (LOS E/F) in the 2030 Baseline Conditions. Two additional ramps are projected to degrade to LOS E/F in 2030 from acceptable LOS D in the 2008 Existing Conditions. Similar to the northbound direction during the morning peak hour, poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream and downstream off-ramps. The remaining four I-95 southbound on-ramps operate at acceptable LOS D or better during the evening peak hour.

I-495 Northbound - During both the morning and evening peak hours, all on-ramps to I-495 northbound within the study area operate at LOS D or better, with the exception of the I-95 northbound on-ramp (Exit 13A). This ramp is projected to degrade to LOS F in the 2030 Baseline Conditions in the morning and evening peak hours.

I-495 Southbound -- During both the morning and evening peak hours, all on-ramps to I-495 southbound within the study area operate at LOS D or better, with the exception of the I-95 southbound on-ramp (Exit 13B). This ramp is projected to degrade to LOS F in the 2030 Baseline Conditions in the morning and evening peak hours.

The results of the diverge analyses include:

I-95 Northbound - During the morning peak hour, eight of the 14 off-ramps from I-95 northbound are projected to continue to operate under congested conditions (LOS E/F). One additional ramp is projected to degrade to LOS E/F in 2030 from acceptable LOS D in the 2008 Existing Conditions. Poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream on-ramps (i.e. a weaving condition). During the evening peak hour, the I-295 off-ramp (Exit 4) is projected to continue to operate at LOS F. Two additional ramps are projected to degrade to LOS E/F in 2030 from acceptable LOS D in the 2008 Existing Conditions. The remaining 11 I-95 northbound off-ramps are project to operate at LOS D or better during the evening peak hour.

I-95 Southbound - All I-95 southbound off-ramps are projected to operate at LOS D or better during the morning peak hour. During the evening peak hour, 12 of the 16 off-ramps from I-95 southbound are projected to continue to operate under congested conditions (LOS E/F). One additional ramp is projected to degrade to LOS E/F in 2030 from acceptable LOS D in the 2008 Existing Conditions. Similar to the northbound direction during the morning peak hour, poor operations at these locations are influenced by heavy mainline volumes, heavy ramp volumes and the presence of upstream on-ramps.

I-495 Northbound - During both the morning and evening peak hours, all off-ramps from I-495 northbound within the study area operate at LOS D or better, with the exception of the I-95 southbound off-ramp (Exit 13B). This ramp is projected to degrade to LOS F in the 2030 Baseline Conditions in the morning and evening peak hours.

I-495 Southbound -- During both the morning and evening peak hours, all off-ramps from I-495 northbound within the study area operate at LOS D or better, with the exception of the Route 1 northbound off-ramp (Exit 14A) which degrades LOS F operations during both the morning and evening peak hours. Also, the I-95 northbound off-ramp (Exit 13A) is projected to degrade to LOS F in the 2030 Baseline Conditions in the morning and evening peak hours.

Table 3-6 I-95 Merge Ramp Capacity Analyses Summary

I-95 Northbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 1	300	25.4	C	200	23.1	C	320	27.2	C	230	24.9	C
Exit 2A	150	23.7	C	50	23.2	C	150	25.9	C	60	26.0	C
Exit 2B	700	27.1	C	550	22.4	C	720	28.6	D	580	23.7	C
Exit 3A	350	24.6	C	150	19.6	B	380	25.9	C	180	20.8	C
Exit 3B	500	27.6	C	300	21.2	C	550	29.2	D	340	22.6	C
Exit 4	1,650	43.0	F	1,550	38.4	E	1,900	47.9	F	1,810	43.7	F
Exit 5	900	37.2	E	400	26.2	C	990	39.9	F	450	28.5	D
Exit 6A	1,000	49.1	F	650	27.1	C	1,140	54.0	F	780	30.3	D
Exit 6B	1,100	38.0	E	400	22.6	C	1,300	41.0	F	490	24.7	C
Exit 7A	100	37.2	E	50	19.4	B	120	40.8	F	70	21.7	C
Exit 7B	850	40.2	F	500	21.9	C	990	43.4	F	610	24.5	C
Exit 8	650	35.1	E	250	19.3	B	770	44.2	F	460	22.4	C
Exit 9	700	31.8	D	500	20.5	C	1,000	36.9	E	840	25.4	C
Exit 10	400	32.8	D	350	21.4	C	540	38.3	F	450	26.0	C
Exit 11A	200	36.7	E	250	21.4	C	330	44.3	F	410	27.9	C
Exit 11B	300	30.2	D	150	21.1	C	490	36.9	E	240	26.6	C

I-95 Southbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Slip Ramp	100	19.0	B	900	36.7	E	160	22.6	C	1,140	43.6	F
Exit 11B	250	18.6	B	350	40.5	F	270	22.6	C	340	52.0	F
Exit 11A	200	18.0	B	350	39.0	F	220	20.6	C	350	43.3	F
Exit 9	550	20.0	B	1,200	37.7	E	620	21.5	C	1,360	41.4	F
Exit 8	450	19.0	B	400	32.2	D	500	20.2	C	600	35.5	E
Exit 7B	300	22.8	C	650	50.8	F	330	24.8	C	740	57.1	F
Exit 7A	350	21.1	C	400	38.9	E	390	22.3	C	430	41.7	F
Exit 6B	900	22.9	C	1,100	45.9	F	1,030	25.4	C	1,310	54.3	F
Exit 6A	750	25.0	C	1,000	36.9	E	860	26.6	C	1,140	44.9	F
Exit 5	600	24.3	C	650	32.3	D	690	26.2	C	760	35.1	E
Exit 4	400	19.8	B	450	24.5	C	470	20.8	C	530	26.1	C
Exit 3B	500	21.9	C	500	26.9	C	560	23.5	C	570	29.4	D
Exit 2B	350	22.4	C	450	31.3	D	380	24.0	C	490	34.0	D
Exit 2A	400	22.1	C	300	22.5	C	440	23.3	C	320	23.9	C

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).

Table 3-7 I-95 Diverge Ramp Capacity Analyses Summary

I-95 Northbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 2A	400	26.8	C	400	24.7	C	450	28.6	D	450	26.4	C
Exit 2B	250	25.4	C	450	20.2	C	280	27.1	C	510	21.8	C
Exit 3A	650	28.7	D	550	24.1	C	720	30.2	D	610	25.5	C
Exit 4	300	59.1	F	550	47.3	F	370	64.3	F	670	52.2	F
Exit 5	500	35.3	E	550	28.5	D	570	37.3	E	610	30.6	D
Exit 6A	1,050	38.0	E	950	28.9	D	1,300	40.3	F	1,130	31.2	D
Exit 6B	1,050	53.7	F	700	32.0	D	1,160	57.3	F	770	35.2	F
Exit 7A	700	35.9	E	350	23.1	C	750	37.8	E	370	25.0	C
Exit 7B	450	31.1	D	250	19.1	B	480	33.8	D	270	21.1	C
Exit 8	500	37.2	E	450	25.3	C	570	39.5	E	630	28.1	D
Exit 9	1,550	39.2	E	600	23.9	C	1,630	41.5	F	670	26.6	C
Exit 11A	600	35.1	E	300	24.3	C	660	39.0	F	340	28.8	D
Exit 11B	500	35.0	D	250	26.0	C	520	47.2	F	290	38.9	F
Slip Ramp		n/a			n/a		240	34.7	D	170	26.2	C

I-95 Southbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 11B	300	22.9	C	350	37.6	E	430	26.7	C	530	42.1	F
Exit 11A	150	23.9	C	350	48.6	F	220	28.0	C	530	52.9	F
Exit 10	400	21.7	C	600	36.4	E	490	24.5	C	760	39.7	F
Exit 9	400	20.2	C	800	35.1	E	600	22.9	C	1,010	38.2	E
Exit 8	250	19.4	B	700	35.3	E	360	21.1	C	1,010	38.2	F
Exit 7B	100	21.8	C	150	34.8	D	110	23.0	C	180	37.0	E
Exit 7A	450	25.8	C	850	56.0	F	500	28.4	D	940	61.5	F
Exit 6B	650	23.0	C	950	35.7	E	750	24.4	C	1,070	38.0	E
Exit 6A	400	29.6	D	900	53.1	F	500	32.0	D	1,130	58.9	F
Exit 5	500	27.0	C	900	37.8	E	580	28.5	D	1,050	40.1	E
Exit 4	1,300	28.6	D	2,300	39.6	F	1,480	30.4	D	2,600	42.4	F
Exit 3B	150	20.6	C	350	25.8	C	160	21.5	C	380	27.2	C
Exit 3A	300	29.1	D	400	35.8	F	320	31.1	D	440	38.7	F
Exit 2B	100	20.9	C	200	24.4	C	110	22.0	C	210	29.8	D
Exit 2A	350	28.7	D	700	35.3	E	370	31.4	D	740	38.0	F
Exit 1	100	22.6	C	200	23.6	C	110	23.8	C	210	25.0	C

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).
n/a not applicable; ramp does not exist under analysis condition

Table 3-8 I-495 Merge Ramp Capacity Analyses Summary

I-495 Northbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 11/12	900	26.7	C	700	26.1	C	1,180	32.8	D	920	31.8	D
Exit 13A	1,050	27.5	C	700	32.5	D	1,160	38.1	F	770	44.6	F
Exit 13B	650	23.1	C	950	26.3	C	750	28.0	C	1,070	31.2	D
Exit 14A	350	20.0	B	200	25.0	C	430	24.6	C	240	31.0	D
Exit 14B	200	20.1	C	450	24.0	C	280	24.1	C	730	29.4	D
Exit 15	400	22.7	C	450	25.4	C	430	25.9	C	480	29.2	D

I-495 Southbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 15	350	22.7	C	650	23.9	C	530	27.6	C	860	28.5	D
Exit 14B	250	23.9	C	550	24.8	C	370	33.1	D	900	33.9	D
Exit 14A	350	23.2	C	250	23.4	C	450	27.9	C	320	28.9	D
Exit 13B	400	29.4	D	900	28.7	D	500	37.9	F	1,130	38.3	F
Exit 13A	1,050	22.8	C	950	25.6	C	1,300	28.4	D	1,130	32.2	D
Exit 11/12	300	17.7	B	600	20.6	C	130	20.1	C	260	21.9	C
Exit 11 Slip	Ramp does not exist in analysis condition						360	24.9	C	690	29.1	D

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).
n/a not applicable; ramp does not exist in analysis condition

Table 3-9 I-495 Diverge Ramp Capacity Analyses Summary

I-495 Northbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 11/12	600	21.4	C	400	20.3	C	760	26.1	C	520	24.8	C
Exit 13A	1,100	28.3	D	400	26.8	C	1,300	33.6	D	490	31.7	D
Exit 13B	900	33.5	D	1,100	32.4	D	1,030	42.5	F	1,310	46.1	F
Exit 14A	550	22.8	C	300	24.7	C	850	27.9	C	500	29.2	D
Exit 14B	200	26.0	C	400	25.6	C	250	33.3	D	500	30.9	D
Exit 15	400	22.8	C	550	26.2	C	540	26.8	C	740	30.9	D

I-495 Southbound

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Ramp Description	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Exit 15	300	24.8	C	550	25.3	C	320	28.4	D	600	28.6	D
Exit 14B	150	23.9	C	350	24.5	C	170	28.3	D	400	28.6	D
Exit 14A	300	27.6	C	250	35.5	E	500	38.4	F	380	46.0	F
Exit 13B	750	25.2	C	1,000	26.2	C	860	29.5	D	1,140	31.4	D
Exit 13A	1,000	29.3	D	650	34.1	D	1,140	38.4	F	780	44.9	F
Exit 11/12	500	15.2	B	1,000	20.4	C	660	20.2	C	1,330	27.2	C

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Volume – Volume in vehicles per hour on the freeway segment.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).
3 LOS – Level of service rating for the freeway segment, ranging from LOS A (best) to LOS F (worst).

3.6.3 Weaving Segment Operations

The analysis of weaving operations at interchange ramps is based on procedures presented in Chapter 24, Freeway Weaving, of the Highway Capacity Manual. The results of the weaving segment analysis for I-95 and I-495 under morning and evening peak hour conditions are summarized in Table 3-10 and Table 3-11, respectively. The results are also presented graphically in the 2030 Baseline Conditions Figures 3-5 through 3-10 for the I-95 and I-495 corridors. Capacity analysis worksheets for weaving segments are included in the Appendix. Key results include:

I-95 Northbound - During the morning peak hour, the following two of the five weaving segments are projected to continue to operate under congested conditions (LOS F):

- I-95 northbound from I-295 on-ramp to I-295 off-ramp (Exit 4); and
- I-95 northbound from I-495 southbound on-ramp to I-495 northbound off-ramp (Exit 6).

Additionally, the weaving segment of I-95 northbound from the Neponset Street eastbound on-ramp to the Neponset Street westbound off-ramp (Exit 11) is projected to degrade from LOS C under 2008 Existing Conditions to LOS E under 2030 Baseline Conditions. The remaining two weaving segments along I-95 northbound are projected to continue to operate at LOS D or better during the morning peak hour.

During the evening peak hour, the weaving segments in the northbound direction are projected to generally operate at acceptable levels within the study area. An exception to this occurs along I-95 northbound from I-295 on-ramp to I-295 off-ramp (Exit 4) which is projected to continue to operate at LOS E.

I-95 Southbound - During the morning peak hour, all weaving segments of I-95 southbound within the study area are projected to operate at LOS C or better. During the evening peak hour, two of the five segments of I-95 southbound are projected to continue to operate under congested conditions (LOS F):

- I-95 southbound from Route 140 northbound on-ramp to Route 140 southbound off-ramp (Exit 7); and
- I-95 southbound from I-495 northbound on-ramp to I-495 southbound off-ramp (Exit 6).

Additionally, the weaving segment of I-95 southbound from the Neponset Street westbound on-ramp to the Neponset Street eastbound off-ramp (Exit 11) is projected to degrade from LOS D under 2008 Existing Conditions to LOS E under 2030 Baseline Conditions. The remaining two weaving segments along I-95 northbound are projected to continue to operate at LOS C during the morning peak hour.

I-495 Northbound - During both the morning and evening peak hours, the weaving segment of I-495 northbound from the I-95 northbound on-ramp to the I-95 southbound off-ramp (Exit 13) is projected to degrade from LOS D under 2008 Existing Conditions to LOS E under 2030 Baseline Conditions. The remaining two weaving segments along I-495 northbound are projected to continue to operate at LOS C or better during the morning and evening peak hours.

I-495 Southbound -- During both the morning and evening peak hours, all weaving segments of I-495 southbound within the study area are projected to continue to operate at LOS D or better.

Table 3-10 I-95 Weaving Segments Capacity Analyses Summary

I-95 Northbound

Weave Segment Description	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
	Dem[1]	Density[2]	LOS[3]	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS
I-95 NB Exit 2	3,650	17.4	B	3,150	15.1	B	3,940	19.1	B	3,430	16.9	B
I-95 NB Exit 4	5,950	41.9	E	4,700	35.7	E	6,490	48.6	F	5,220	42.7	E
I-95 NB Exit 6	6,000	42.0	E	3,700	22.7	C	6,380	46.8	F	4,040	26.1	C
I-95 NB Exit 7	5,450	28.4	D	3,100	13.9	B	5,890	31.6	D	3,460	15.9	B
I-95 NB Exit 11	5,150	27.4	C	3,350	16.0	B	6,180	35.1	E	4,320	22.4	C

I-95 Southbound

Weave Segment Description	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS
I-95 SB Exit 11	3,000	13.8	B	6,100	33.9	D	3,540	17.1	B	7,120	42.3	E
I-95 SB Exit 7	3,200	16.2	B	6,100	38.9	E	3,430	17.8	B	6,680	44.5	F
I-95 SB Exit 6	3,350	20.8	C	5,800	40.8	E	3,600	23.9	C	6,410	49.1	F
I-95 SB Exit 3	3,250	16.5	B	3,950	20.8	C	3,460	18.0	B	4,250	23.2	C
I-95 SB Exit 2	3,200	16.1	B	3,800	21.9	C	3,410	17.5	B	4,090	24.1	C

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Demand – Weave segments demand in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

Table 3-11 I-495 Weaving Segments Capacity Analyses Summary

	I-495 Northbound											
	2008 Existing Conditions						2030 Baseline Conditions					
Weave Segment Description	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
	Dem[1]	Density[2]	LOS[3]	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS
I-495 NB Exits 11/12 C-D Roadway	1,450	19.3	B	950	10.7	A	1,865	26.3	C	1,235	15.1	B
I-495 NB Exit 13	3,850	28.1	D	4,200	28.7	D	4,790	35.5	E	5,170	36.7	E
I-495 NB Exit 14	3,400	16.0	B	3,950	19.1	B	4,090	20.2	C	4,670	23.8	C

	I-495 Southbound											
	2008 Existing Conditions						2030 Baseline Conditions					
Weave Segment Description	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS	Dem	Density	LOS
I-495 SB Exit 14	3,750	18.2	B	3,900	20.2	C	4,700	25.3	C	4,990	29.6	D
I-495 SB Exit 13	3,450	22.3	C	3,800	25.4	C	4,290	28.9	D	4,920	34.9	D
I-495 SB Exits 11/12 C-D Roadway	700	7.9	A	1,650	19.2	B	650	7.4	A	1,645	18.4	B

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Demand – Weave segments demand in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

3.6.4 Intersection Operations

Capacity analyses were conducted for the signalized and unsignalized intersections within the study area to assess the quality of traffic flow.

I-95/I-495 Intersection Operations

Capacity analyses were conducted at all intersections of ramp termini with local streets within the study area. In addition, capacity analyses were conducted at several predefined intersections within the study area that are adjacent to the I-95 and I-495 mainlines and are potentially impacted by traffic entering onto or exiting from I-95 and I-495.

The results of signalized and unsignalized intersection capacity analysis for I-95 and I-495 interchanges under morning and evening peak hour conditions are summarized in Table 3-12 and Table 3-13, respectively. These results are also presented graphically in the future conditions figures for each of the individual interchanges along I-95 and for I-495 (Figure 3-11 through 3-22). Capacity analysis worksheets are included in the Appendix.

Key results at signalized intersections include:

I-95 - Eight of the 12 signalized study area intersections are projected to operate at LOS D or better**.** The following four intersections are projected to operate at LOS E/F during one of both peak hours in the 2030 Baseline Condition:

- Route 140 at Forbes Boulevard (Exit 7)
- Mechanic Street/South Main Street at I-95 NB ramps (Exit 8)
- Mechanic Street at Oak Street (Exit 8)
- Neponset Street at Wedgewood Drive (Exit 11)

I-495 – Five of the six signalized study area intersections are projected to operate at LOS D or better**.** During the evening peak hour, the intersection of Route 140 at School Street (Exit 11/12) will operate at LOS F.

Table 3-12 Signalized Intersection Capacity Analysis Summary

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]
Toner Blvd. at Burden Ave./North Ave.	EB LT-TH	0.43	17	B	234	0.40	23	C	189	0.52	20	C	#307	0.59	31	C	#236
(I-95 Exit 5)	EB RT	0.13	6	A	27	0.12	8	A	28	0.16	6	A	36	0.13	9	A	26
	WB LT	0.19	6	A	28	0.43	24	C	180	0.26	9	A	45	0.59	31	C	#230
	WB TH-RT	0.21	5	A	56	0.44	25	C	302	0.25	7	A	90	0.56	30	C	297
	NB LT	0.61	36	D	137	0.69	37	D	187	0.60	33	C	148	0.65	31	C	205
	NB TH-RT	0.16	31	C	32	0.10	28	C	33	0.18	29	C	32	0.11	24	C	32
	SB LT-TH-RT	0.27	44	D	25	0.20	44	D	16	0.27	44	D	25	0.20	44	D	16
	Overall	*0.46*	*17*	*B*		*0.50*	*25*	*C*		*0.52*	*18*	*B*		*0.59*	*29*	*C*	
Toner Blvd. at Triboro Plaza driveway	EB LT	0.09	5	A	42	0.42	18	B	108	0.09	5	A	m40	0.47	29	C	117
(I-95 Exit 5)	EB TH	0.30	7	A	288	0.19	3	A	51	0.35	7	A	333	0.23	3	A	62
	WB TH-RT	0.20	3	A	33	0.47	4	A	32	0.23	2	A	25	0.54	5	A	78
	SB LT	0.32	41	D	44	0.53	39	D	107	0.32	41	D	44	0.53	39	D	107
	SB RT	0.03	39	D	23	0.12	36	D	55	0.03	39	D	23	0.12	36	D	55
	Overall	*0.30*	*7*	*A*		*0.47*	*10*	*A*		*0.35*	*7*	*A*		*0.53*	*11*	*B*	
Toner Blvd. at John Dietsch Blvd.	EB LT	0.12	3	A	15	0.18	14	B	42	0.16	3	A	35	0.34	28	C	70
(I-95 Exit 5)	EB TH	0.34	6	A	286	0.25	13	B	187	0.40	7	A	328	0.35	20	B	218
	WB TH	0.20	5	A	50	0.55	12	B	158	0.24	4	A	46	0.80	18	B	#410
	WB RT	0.20	2	A	3	0.24	8	A	m41	0.25	4	A	4	0.37	11	B	m68
	SB LT	0.68	41	D	147	0.79	38	D	193	0.73	42	D	170	0.72	27	C	215
	SB RT	0.04	31	C	26	0.07	24	C	13	0.04	30	C	26	0.08	18	B	11
	Overall	*0.40*	*9*	*A*		*0.63*	*17*	*B*		*0.47*	*10*	*A*		*0.75*	*20*	*B*	
Toner Blvd. at I-95 SB Exit 5 Ramps	EB LT	0.36	3	A	26	0.47	6	A	m97	0.50	6	A	61	0.79	25	C	141
(I-95 Exit 5)	EB TH	0.29	2	A	36	0.24	4	A	111	0.32	3	A	43	0.34	10	A	114
	WB TH	0.23	7	A	92	0.37	12	B	210	0.28	13	B	m181	0.60	36	D	m250
	WB RT	0.28	8	A	30	0.21	11	B	49	0.30	65	E	m144	0.23	>120	F	m93
	SB LT	0.53	39	D	88	0.51	33	C	108	0.57	39	D	99	0.35	24	C	136
	SB RT	0.14	36	D	61	0.61	37	D	148	0.17	35	D	67	0.72	32	C	#362
	Overall	*0.38*	*11*	*B*		*0.48*	*17*	*B*		*0.50*	*22*	*C*		*0.75*	*37*	*D*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 3-12 Signalized Intersection Capacity Analysis Summary (cont.)

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]	V/C	Delay	LOS	Q	V/C	Delay	LOS	Q[4]
Toner Blvd. at I-95 NB Exit 5 Ramps	EB LT	*Location Unsignalized See Table 3-13*								1.10	89	F	#410	0.78	52	D	#60
(I-95 Exit 5)	EB TH									0.46	5	A	20	0.67	12	B	434
	WB TH									1.02	59	E	#647	0.94	27	C	#719
	WB RT									0.43	7	A	50	0.18	1	A	1
	SB LT									1.07	118	F	#308	0.95	66	E	#408
	SB RT									0.15	35	C	65	0.14	27	C	56
	Overall									*1.06*	*50*	*D*		*0.94*	*28*	*C*	
Toner Blvd. at Route 152	EB LT	0.69	37	D	191	1.06	94	F	#468	0.68	34	C	m145	0.74	31	C	m257
(I-95 Exit 5)	EB RT	0.34	30	C	57	0.67	36	D	#247	0.38	36	D	m21	0.85	47	D	m238
	NB LT	0.79	15	B	299	0.85	21	C	339	0.48	11	B	148	0.64	19	B	#224
	NB TH	0.18	5	A	68	0.17	6	A	64	0.20	6	A	98	0.23	12	B	127
	SB TH	0.20	22	C	85	0.45	27	C	165	0.18	19	B	84	0.70	39	D	190
	SB RT	0.21	23	C	65	0.24	25	C	62	0.23	20	C	63	0.26	32	C	70
	Overall	*0.77*	*22*	*C*		*0.91*	*36*	*D*		*0.53*	*21*	*C*		*0.75*	*33*	*C*	
Route 140 at Fisher Street	EB LT-RT	0.49	42	D	120	0.60	48	D	#129	0.53	42	D	132	0.70	54	D	#168
(I-95 Exit 7)	NB LT	0.07	4	A	m2	0.22	6	A	m5	0.11	5	A	m4	0.31	15	B	m7
	NB TH	0.61	9	A	m132	0.60	6	A	m134	0.74	10	A	m374	0.70	7	A	m173
	SB TH-RT	0.49	8	A	252	0.53	8	A	248	0.54	9	A	294	0.62	10	B	308
	Overall	*0.59*	*10*	*A*		*0.60*	*8*	*A*		*0.71*	*11*	*B*		*0.70*	*10*	*B*	
Route 140 at Forbes Blvd.	EB LT	>1.20	>120	F	#325	>1.20	>120	F	#490	>1.20	>120	F	#370	>1.20	>120	F	#571
(I-95 Exit 7)	EB LT-TH	>1.20	>120	F	#334	>1.20	>120	F	#501	>1.20	>120	F	#395	>1.20	>120	F	#604
	EB RT	0.00	40	D	13	0.01	28	C	16	0.00	41	D	13	0.01	28	C	18
	WB LT	0.23	41	D	#40	1.07	>120	F	#106	0.31	45	D	#44	>1.20	>120	F	#134
	WB TH	0.40	42	D	#131	1.03	>120	F	#147	0.72	58	E	#181	>1.20	>120	F	#203
	WB RT	0.59	46	D	#217	>1.20	>120	F	#233	>1.20	>120	F	#325	>1.20	>120	F	#318
	NB LT	0.04	15	B	10	0.12	24	C	12	0.06	13	B	12	0.16	27	C	16
	NB TH	0.47	21	C	192	0.56	31	C	215	0.56	20	B	294	0.72	35	C	286
	NB RT	0.03	16	B	18	0.04	24	C	24	0.04	14	B	26	0.07	25	C	36
	SB LT	0.50	14	B	124	0.60	25	C	171	0.57	26	C	163	0.72	40	D	206
	SB TH	0.32	11	B	92	0.82	26	C	#508	0.33	11	B	121	0.99	47	D	#671
	SB RT	0.29	10	A	20	0.22	20	B	71	0.31	18	B	50	0.26	25	C	93
	Overall	*0.62*	*49*	*D*		*1.11*	*>120*	*F*		*0.77*	*104*	*F*		*>1.20*	*>120*	*F*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 3-12 Signalized Intersection Capacity Analysis Summary (cont.)

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]	V/C	Delay	LOS	Q	V/C	Delay	LOS	Q[4]
Mechanic Street at I-95 NB Exit 8 Ramps	EB TH									0.42	11	B	m239	0.64	16	B	m362
(I-95 Exit 8)	EB RT									0.36	20	C	m80	0.13	17	B	m23
	WB LT									0.35	11	B	116	0.88	41	D	#284
	WB TH	*Location Unsignalized See Table 3-13*								0.56	13	B	392	1.08	66	E	#1068
	NB LT									0.15	26	C	46	0.19	29	C	70
	NB RT									0.83	44	D	191	>1.20	>120	F	#525
	Overall									*0.64*	*21*	*C*		*1.15*	*77*	*E*	
Mechanic Street at I-95 SB Exit 8 Ramps	EB LT-TH									0.80	11	B	418	0.99	55	D	#592
(I-95 Exit 8)	WB TH									0.19	3	A	47	0.69	13	B	m129
	WB RT	*Location Unsignalized See Table 3-13*								0.31	6	A	32	0.43	14	B	m21
	SB LT									0.64	46	D	#135	0.51	22	C	229
	SB RT									0.13	37	D	60	1.06	82	F	#626
	Overall									*0.78*	*13*	*B*		*1.02*	*40*	*D*	
Mechanic Street at Oak Street	EB LT-TH-RT	0.64	8	A	146	0.73	19	B	137	0.66	9	A	179	0.79	20	B	182
(I-95 Exit 8)	WB LT	n/a	n/a	n/a	n/a	1.19	112	F	#269	n/a	n/a	n/a	n/a	>120	>120	F	#544
	WB TH-RT	n/a	n/a	n/a	n/a	0.57	5	A	93	n/a	n/a	n/a	n/a	0.66	5	A	119
	WB LT-TH-RT[5]	0.35	6	A	34	n/a	n/a	n/a	n/a	0.46	6	A	49	n/a	n/a	n/a	n/a
	NB LT	0.13	12	B	25	0.72	41	D	#80	0.17	13	B	34	0.98	105	F	#119
	NB TH-RT	0.23	12	B	2	0.14	23	C	0	0.29	14	B	32	0.20	27	C	0
	Overall	*0.53*	*9*	*A*		*1.07*	*46*	*D*		*0.57*	*10*	*A*		*>1.20*	*>120*	*F*	
Neponset Street at Wedgewood Drive	EB LT-TH-RT	0.57	47	D	86	0.51	44	D	69	0.59	48	D	86	0.13	14	B	39
(I-95 Exit 11)	WB LT-TH-RT	0.27	49	D	10	0.48	55	D	12	0.26	49	D	10	0.02	13	B	6
	NB LT-TH-RT	0.94	25	C	#1184	0.80	13	B	#904	1.08	60	E	#1484	>1.20	>120	F	#2005
	SB LT-TH-RT	0.59	8	A	425	1.00	36	D	#1187	0.67	8	A	534	>1.20	>120	F	#1819
	Overall	*0.88*	*20*	*B*		*0.93*	*27*	*C*		*1.01*	*41*	*D*		*>1.20*	*>120*	*F*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
5 Mechanic Street westbound approach operates as a defacto left-turn lane and a shared through/right-turn lane during the evening peak hour; analysis adjusted to reflect operating conditions.
95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
n/a not applicable
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 3-12 Signalized Intersection Capacity Analysis Summary (cont.)

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]	V/C	Delay	LOS	Q	V/C	Delay	LOS	Q[4]
Route 140 at I-495/	NB LT									0.67	6	A	#108	1.07	68	E	#268
C-D Roadway NB ramps	NB LT-TH									0.41	1	A	0	0.15	0	A	0
(I-495 Exit 11/12)	SB LT	*Location Unsignalized See Table 3-13*								0.66	10	B	141	0.98	33	C	#395
	SB RT									0.29	7	A	47	0.15	5	A	25
	Overall									*0.63*	*5*	*A*		*1.00*	*33*	*C*	
Route 140 at I-495/	EB LT									0.39	26	C	64	0.84	55	D	#264
C-D Roadway SB ramps	EB RT									0.18	12	B	15	0.49	13	B	131
(I-495 Exit 11/12)	NB TH-RT	*Location Unsignalized See Table 3-13*								0.88	24	C	#410	0.89	36	D	#420
	SB LT									0.88	45	D	#273	0.95	46	D	#506
	SB TH									0.17	12	B	48	0.27	21	C	95
	Overall									*0.79*	*23*	*C*		*0.93*	*31*	*C*	
Route 140 at School Street	EB LT	0.42	44	D	69	0.66	48	D	110	0.46	44	D	77	0.75	53	D	#138
(I-495 Exit 11/12)	EB TH	0.68	46	D	184	1.06	112	F	#396	0.71	45	D	205	>1.20	>120	F	#473
	EB RT	0.05	35	D	38	0.13	36	D	61	0.06	34	C	38	0.22	37	D	81
	WB LT	0.76	44	D	#261	0.64	42	D	156	0.70	46	D	161	0.41	36	D	115
	WB TH	0.17	31	C	60	0.69	42	D	161	0.26	36	D	69	0.74	42	D	191
	WB RT	0.04	30	C	30	0.04	34	C	27	0.05	34	C	33	0.05	33	C	29
	NB LT	1.20	>120	F	#132	>1.20	>120	F	#231	>1.20	>120	F	#172	>1.20	>120	F	#283
	NB TH	0.63	27	C	278	0.35	26	C	161	0.70	26	C	369	0.50	31	C	202
	NB RT	0.19	21	C	52	0.12	23	C	51	0.27	19	B	89	0.15	26	C	57
	SB LT	0.19	25	C	31	0.55	22	C	157	0.28	24	C	38	0.75	27	C	#215
	SB TH	0.26	29	C	92	0.94	53	D	#421	0.18	27	C	68	0.73	38	D	279
	SB RT	0.04	26	C	28	0.39	32	C	139	0.05	26	C	32	0.59	38	D	221
	Overall	*0.77*	*42*	*D*		*>1.20*	*77*	*E*		*0.88*	*51*	*D*		*>1.20*	*102*	*F*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
\# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Table 3-12 Signalized Intersection Capacity Analysis Summary (cont.)

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Lane Group	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]	V/C[1]	Delay[2]	LOS[3]	Q[4]	V/C	Delay	LOS	Q[4]
Route 1A at Premium Outlet Blvd.	EB LT	0.52	35	D	58	0.96	53	D	#363	0.57	37	D	64	0.99	62	E	#395
(I-495 Exit 15)	EB LT-TH	0.54	36	D	60	0.96	55	E	#365	0.57	38	D	64	0.99	63	E	#392
	EB RT	0.02	32	C	21	0.13	16	B	31	0.02	31	C	24	0.13	16	B	32
	WB LT-TH	0.53	34	C	36	0.45	35	D	41	0.53	34	C	36	0.45	35	D	41
	WB RT	0.05	29	C	23	0.07	33	C	37	0.05	29	C	24	0.07	33	C	38
	NB LT	0.15	10	A	47	0.53	23	C	71	0.18	10	B	51	0.58	25	C	76
	NB TH-RT	0.42	16	B	182	0.43	27	C	108	0.48	16	B	208	0.51	29	C	122
	SB LT	0.13	6	A	17	0.17	18	B	m19	0.15	6	A	12	0.18	21	C	m17
	SB TH	0.18	9	A	71	0.84	31	C	#213	0.21	10	A	88	0.99	52	D	#256
	SB RT	0.11	14	B	52	0.31	32	C	m66	0.12	16	B	65	0.32	26	C	m28
	Overall	*0.39*	*17*	*B*		*0.84*	*37*	*D*		*0.43*	*18*	*B*		*0.90*	*43*	*D*	
Route 1A at I-495 SB Exit 15 off-ramp	EB LT	0.51	34	C	76	0.57	34	C	#103	0.50	32	C	86	0.76	46	D	#158
(I-495 Exit 15)	EB RT	0.09	30	C	41	0.28	30	C	59	0.10	28	C	41	0.29	31	C	60
	NB LT	0.24	8	A	123	0.80	15	B	m140	0.35	11	B	161	0.89	22	C	m177
	NB TH	0.24	7	A	165	0.28	2	A	m10	0.26	9	A	183	0.29	1	A	m10
	SB TH	0.20	4	A	25	0.49	10	B	181	0.23	6	A	45	0.61	15	B	228
	SB RT	0.14	0	A	0	0.10	9	A	39	0.27	8	A	0	0.21	21	C	50
	Overall	*0.28*	*9*	*A*		*0.74*	*13*	*B*		*0.36*	*11*	*B*		*0.85*	*18*	*B*	
Route 1A at I-495 NB Exit 15 off-ramp	WB LT	0.12	6	A	30	0.21	8	A	79	0.17	8	A	45	0.28	12	B	111
(I-495 Exit 15)	WB RT	0.10	6	A	11	0.15	8	A	34	0.21	9	A	12	0.27	13	B	64
	NB TH	0.39	26	C	108	0.42	14	B	59	0.33	22	C	119	0.37	12	B	71
	NB RT	0.25	88	F	160	0.27	16	B	16	0.25	85	F	160	0.27	18	B	m16
	SB LT-TH	0.66	32	C	117	0.72	29	C	154	0.69	28	C	142	0.74	25	C	178
	Overall	*0.27*	*38*	*D*		*0.38*	*17*	*B*		*0.38*	*33*	*C*		*0.49*	*17*	*B*	

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn; UT = u-turn

Key results at unsignalized intersections include:

I-95 Exit 1 – During the evening peak hour, the eastbound and westbound approaches to the Route 1 at Scott Street intersection will operate at LOS F under the 2030 Baseline Conditions.

I-95 Exit 2 – During the morning peak hour, the westbound approach of the intersection of Route 1A at MBTA Commuter Rail Station/Bristol Place will continue to operate at LOS F. Additionally, the I-95 NB Exit 2B off-ramp is projected to degrade to LOS E under the 2030 Baseline Conditions in the weekday morning. Three out of four minor street approaches of intersections of the I-95 off-ramps with Route 1A will continue to operate at LOS F during the evening peak hour, with the exception of the intersection of Route 1 A at I-95 SB Exit 2B off-ramp. Additionally, the eastbound and westbound minor street approaches of Route 1A at MBTA Commuter Rail Station/Bristol Place are projected to continue to operate at LOS F during the evening peak hour.

I-95 Exit 3 – During the morning peak hour, the southbound approach of the intersection of Route 123 at Lathrop Drive will continue to operate at LOS F. Under the 2030 Baseline Condition, northbound left-turn and right-turn movements at the intersection of Route 123 at I-95 NB Exit 3A off-ramps are projected to degrade to LOS E during the morning peak hour. At the intersection of Route 123 at I-95 NB Exit 3A off-ramps, the northbound left-turn and right-turn movements are projected to continue to operate at LOS F during the evening peak hour. Additionally, the southbound approach of the intersection of Route 123 at Lathrop Drive will continue to operate at LOS F during the evening peak hour.

I-95 Exit 7 – The minor street approaches of the intersections of Route 140 at Walnut Street and Route 140 at I-95 NB Exit 7A off-ramp will continue to operate at LOS F during both peak hours. The minor street approach of the intersection of Route 140 at I-95 SB Exit 7A off-ramp will also continue to operate at LOS F during the evening peak hour. Additionally, the minor street approach of the intersection of Route 140 at I-95 NB Exit 7B off-ramp is projected to degrade to LOS F during both peak hours.

I-95 Exit 10 – During the morning peak hour, the eastbound approach of the intersection of Coney Street at Rustic Road will operate at LOS F. The minor street approaches of the intersections of Coney Street at I-95 SB Exit 10 off-ramp and Coney Street at Rustic Road all are projected to continue to operate at LOS F during the evening peak hour.

I-95 Exit 11 – During the morning peak hour, the minor street approaches of the intersections of Neponset Street at I-95 NB Exit 11A and Exit 11B off-ramps will continue to operate poorly at LOS F during the morning peak hour. Additionally during the morning peak hour, the minor street approach of the intersection of Neponset Street at I-95 SB Exit 11B off-ramps will degrade to LOS F. Three out of four minor street approaches of intersections of the I-95 off-ramps with Neponset Street are projected to degrade to LOS E/F during the evening peak hour, with the exception of the intersection of Neponset Street at I-95 NB Exit 11B off-ramp.

I-495 Exit 11/12 –The eastbound left-turn movement from the Comcast center main driveway to Route 140 will degrade to LOS E in the evening peak hour.

Table 3-13 Unsignalized Intersection Capacity Analysis Summary

		2008 Existing Conditions										2030 Baseline Conditions									
		Weekday Morning					Weekday Evening					Weekday Morning					Weekday Evening				
Intersection	Critical Movement(s)	Dem[1]	v/c[2]	Del[3]	LOS[4]	Q[5]	Dem	v/c	Del	LOS	Q	Dem	v/c	Del	LOS	Q	Dem	v/c	Del	LOS	Q
I-95 Exit 1																					
Route 1 at I-95 SB Exit 1 off-ramp	SE RT	100	0.15	11	B	13	200	0.35	14	B	38	110	0.17	11	B	16	210	0.38	15	B	44
Route 1 at Scott Street	EB LT-TH-RT	5	0.08	22	C	6	neg	0.15	57	F	12	5	0.08	23	C	7	neg	0.19	74	F	16
	WB LT-TH-RT	45	0.13	15	B	11	130	0.64	47	E	95	45	0.13	15	C	11	135	0.79	73	F	132
I-95 Exit 2																					
Route 1A at I-95 SB Exit 2B off-ramp	NW RT	100	0.16	12	B	15	200	0.48	20	C	64	110	0.19	12	B	17	210	0.56	24	C	83
Route 1A at I-95 SB Exit 2A off-ramp	SE RT	350	0.58	18	C	93	700	1.18	118	F	639	370	0.63	20	C	111	740	>1.20	>120	F	803
Route 1A at I-95 NB Exit 2B off-ramp	NW RT	250	0.45	16	C	57	450	1.08	96	F	400	280	0.53	18	C	76	510	>1.20	>120	F	638
Route 1A at I-95 NB Exit 2A off-ramp	SE RT	400	0.78	30	D	179	400	1.15	>120	F	417	450	0.92	49	E	276	450	>1.20	>120	F	604
Route 1A at MBTA Commuter Rail	EB RT	90	0.36	19	C	41	335	>1.20	>120	F	572	100	0.44	23	C	55	370	>1.20	>120	F	764
Station/Bristol Place	WB RT	170	0.80	48	E	169	455	>1.20	>120	F	862	190	0.96	78	F	246	505	>1.20	>120	F	1118
I-95 Exit 3																					
Route 123 at I-95 NB Exit 3A off-ramp	NB LT	45	0.23	25	C	21	50	0.46	56	F	51	80	0.46	37	E	56	80	0.92	>120	F	135
	NB RT	470	0.84	32	D	229	505	1.04	77	F	407	505	0.94	47	E	318	535	1.20	>120	F	568
Route 123 at Lathrop Drive	SB LT-RT	210	>1.20	>120	F	389	390	>1.20	>120	F	858	220	>1.20	>120	F	568	415	>1.20	Err	F	Err
I-95 Exit 5																					
Toner Blvd. at I-95 NB Ramps	SB LT	220	>1.20	Err	F	Err	370	>1.20	Err	F	Err	*Location Signalized - See Table 3-12*									
	SB RT	185	0.48	22	C	63	185	0.59	31	D	90										
I-95 Exit 7																					
Route 140 at Walnut Street	EB LT-TH-RT	130	0.82	77	F	144	65	0.71	83	F	99	140	1.09	>120	F	218	70	1.15	>120	F	172
	WB LT-TH-RT	25	>1.20	>120	F	130	50	>1.20	>120	F	208	25	>1.20	Err	F	Err	50	>1.20	Err	F	Err
Route 140 at I-95 SB Exit 7B off-ramp	NW RT	110	0.21	13	B	20	150	0.26	13	B	25	120	0.27	15	B	27	180	0.33	14	B	36
Route 140 at I-95 SB Exit 7A off-ramp	SE RT	460	0.66	18	C	124	880	>1.20	>120	F	1081	510	0.75	23	C	172	970	>1.20	>120	F	1572
Route 140 at I-95 NB Exit 7B off-ramp	NW RT	490	0.81	30	D	211	250	0.60	25	C	98	520	0.99	61	F	353	270	0.74	36	E	147
Route 140 at I-95 NB Exit 7A off-ramp	SE RT	715	>1.20	>120	F	870	360	1.09	109	F	359	765	>1.20	>120	F	1101	380	>1.20	>120	F	533
I-95 Exit 8																					
S. Main St. at I-95 NB Exit 8 off-ramp	NB LT	40	0.71	23	C	153	50	0.70	26	D	145	*Location Signalized - See Table 3-12*									
S. Main St. at I-95 SB Exit 8 off-ramp	SB LT	35	0.21	14	B	20	120	1.09	78	F	534	*Location Signalized - See Table 3-12*									
I-95 Exit 10																					
Coney Street at I-95 SB Exit 10 off-ramp	WB LT	115	0.63	23	C	114	260	>1.20	>120	F	715	180	0.70	30	D	148	380	>1.20	>120	F	1747
Coney Street at Rustic Road	EB LT-TH-RT	20	0.26	46	E	24	120	0.57	63	F	71	20	0.29	51	F	27	130	0.72	93	F	98
	WB LT-TH-RT	30	0.23	28	D	21	55	0.75	89	F	108	30	0.24	30	D	23	55	0.89	>120	F	133
I-95 Exit 11																					
Neponset Street at I-95 SB Exit 11B off-ramp	SW RT	300	0.63	23	C	109	350	0.61	19	C	103	430	0.98	67	F	318	530	0.98	60	F	353
Neponset Street at I-95 SB Exit 11A off-ramp	NE RT	150	0.23	12	B	23	350	0.66	23	C	123	220	0.38	14	B	44	530	1.10	96	F	456
Neponset Street at I-95 NB Exit 11B off-ramp	SW RT	500	0.86	36	E	244	250	0.47	17	C	63	520	0.97	57	F	337	290	0.56	19	C	86
Neponset Street at I-95 NB Exit 11A off-ramp	NE RT	660	0.92	38	E	319	300	0.67	26	D	122	720	1.04	67	F	477	340	0.84	44	E	206
I-495 Exit 11/12																					
Route 140 at I-495/C-D Roadway SB off-ramp	EB LT	25	0.48	13	B	65	85	1.06	68	F	531	*Location Signalized - See Table 3-12*									
Route 140 at Comcast Center main driveway	EB LT	5	0.03	21	C	2	15	0.05	25	C	4	5	0.05	31	D	4	15	0.10	41	E	8
	EB RT	5	0.02	10	B	1	neg	0.00	11	B	0	5	0.02	11	B	2	neg	0.00	13	B	0

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 Dem – Demand.
2 V/C – Volume-to-capacity ratio. Values over 1.0 indicate demand in excess of capacity.
3 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
4 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
5 Q – 95th percentile queue length estimate, in feet.
n/a not applicable
Neg Negligible
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn
n/a not applicable; intersection signalized in analysis condition.

I-95 Exit 9 – Route 1 Operations

The locations where I-95 Exit 9 ramp termini intersect with Route 1 present special analyses conditions. These locations are a series ramp merges and diverges and there are weaving segments along Route 1 northbound and southbound. Ramp merge, diverge and weaving segment capacity analyses for the morning and evening peak hour conditions are summarized in Table 3-14, Table 3-15, and Table 3-16 respectively. These results are also presented graphically in the 2030 Baseline Conditions figure for the Route 1 and I-95 Exit 9 interchange (Figure 3-17). Capacity analysis worksheets are included in the Appendix. Key results include:

Route 1 Northbound – During the weekday morning, the weaving segment from I-95 NB off-ramp to I-95 NB on-ramp is projected to degrade from LOS E under 2008 Existing Conditions to LOS F under 2030 Baseline Conditions. During the weekday evening, the Route 1 northbound weaving segment is projected to degrade from LOS C under 2008 Existing Conditions to LOS E under 2030 Baseline Conditions.

Route 1 Southbound – The weaving segment from I-95 SB off-ramp to I-95 SB on-ramp is projected to continue to operate at LOS F during the evening peak hour.

Table 3-14 I-95 Exit 9 – Route 1 Merge Ramp Capacity Analyses Summary

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Location	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Route 1 SB U-turn merge with Route 1 NB	40	13.4	B	50	14.6	B	40	17.0	B	50	22.2	C
I-95 NB off-ramp merge with Route 1 NB	1,550	25.8	C	600	19.2	B	1,630	29.9	D	670	27.3	C
I-95 SB off-ramp merge with Route 1 SB	400	15.2	B	800	26.1	C	600	21.7	C	1,010	32.3	D

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 3-15 I-95 Exit 9 – Route 1 Diverge Ramp Capacity Analyses Summary

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Location	Volume[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
I-95 NB on-ramp diverge from Route 1 NB	700	27.4	C	500	19.5	B	1,000	32.0	D	840	28.6	D
I-95 SB on-ramp diverge from Route 1 SB	550	14.6	B	1,200	26.8	C	620	21.9	C	1,360	33.8	D
Route 1 SB U-turn diverge from Route 1 SB	40	9.8	A	50	15.8	B	40	16.4	B	50	21.3	C

Source: VHB, Inc. using HCS2000 methodologies.
1 Volume – Ramp volume in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the ramp, ranging from LOS A (best) to LOS F (worst).

Table 3-16 I-95 Exit 9 – Route 1 Weaving Segment Capacity Analyses Summary

	2008 Existing Conditions						2030 Baseline Conditions					
	Weekday Morning			Weekday Evening			Weekday Morning			Weekday Evening		
Location	Dem[1]	Density[2]	LOS[3]	Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
Route 1 NB: I-95 NB off-ramp to I-95 NB on-ramp	2,505	41.2	E	1,685	23.2	C	2,990	51.2	F	2,630	38.4	E
Route 1 SB: I-95 SB off-ramp to I-95 SB on-ramp	1,365	21.4	C	2,640	50.6	F	2,120	34.6	D	3,370	67.2	F

Source: VHB, Inc. using HCS2000 methodologies.
Note: Shaded cells denote LOS E or LOS F conditions.
1 Demand – Weave segments demand in vehicles per hour.
2 Density – Expressed in passenger cars per mile per lane.
3 LOS – Level of service rating for the weave segment, ranging from LOS A (best) to LOS F (worst).

Route 1 Intersection Operations

Capacity analyses were also conducted at Route 1 study area intersections. The results of signalized and unsignalized intersection capacity analysis for Route 1 under morning and evening peak hour conditions are summarized in Table 2-35 and Table 2-36, respectively. These results are also presented graphically in the 2030 Baseline conditions figures for Route 1 study area intersections (Figures 3-23 through 3-43). Capacity analysis worksheets are also included in the Appendix.

Under the 2030 Baseline Condition, 19 of the 37 signalized intersections along Route 1 will operate at acceptable LOS D or better during both peak hours. The remaining 18 Route 1 signalized intersections are projected to operate at LOS E/F during one or both of the peak hours.

The minor street approaches at all four Route 1 unsignalized intersections operate at LOS E/F during at least one peak hour.

Table 3-17 Signalized Intersection Capacity Analysis Summary

		2008 Existing Conditions			2030 Baseline Conditions		
Intersection	Time Period	V/C[1]	Delay[2]	LOS[3]	V/C[1]	Delay[2]	LOS[3]
#79 Bridge Street (Route 109) at Providence Highway - Boston	Weekday Morning	>1.20	>120	F	>1.20	>120	F
	Weekday Evening	>1.20	>120	F	>1.20	>120	F
#80 Washington Street (north) at Providence Highway [4] - Dedham	Weekday Morning	0.68	18	B	0.77	21	C
	Weekday Evening	0.72	21	C	0.84	24	C
#80 Washington Street (south) at Providence Highway [4] - Dedham	Weekday Morning	0.75	24	C	0.85	30	C
	Weekday Evening	0.75	34	C	0.88	48	D
#81 Eastern Avenue at Providence Highway - Dedham	Weekday Morning	0.93	>120	F	0.76	40	D
	Weekday Evening	1.16	>120	F	0.85	61	E
#82 Elm Street at Providence Highway -Dedham	Weekday Morning	>1.20	>120	F	1.05	93	F
	Weekday Evening	>1.20	>120	F	>1.20	94	F
#83 Everett Street at Route 1[4] - Norwood	Weekday Morning	>1.20	>120	F	>1.20	>120	F
	Weekday Evening	>1.20	>120	F	>1.20	>120	F
#85 Dean Street at Route 1 - Norwood	Weekday Morning	>1.20	>120	F	0.71	33	C
	Weekday Evening	>1.20	>120	F	0.76	37	D
#85 Dean Street at Route 1 southbound ramps - Norwood	Weekday Morning	*Location Unsignalized –*			0.47	58	E
	Weekday Evening	*See Table 3-18*			0.54	60	E
#85 Dean Street at Route 1 northbound ramps - Norwood	Weekday Morning	*Location Unsignalized –*			0.42	36	D
	Weekday Evening	*See Table 3-18*			0.50	59	E
#86 Morse Street at Route 1 - Norwood	Weekday Morning	0.85	39	D	0.92	56	E
	Weekday Evening	0.97	61	E	1.15	80	E
#87 Sumner Street at Route 1 - Norwood	Weekday Morning	0.80	23	C	0.78	31	C
	Weekday Evening	0.79	23	C	0.83	43	D
#88 Union Street at Route 1- Norwood	Weekday Morning	1.05	55	E	1.11	69	E
	Weekday Evening	1.20	80	E	>1.20	>120	F
#89 Coney Street at Route 1 - Walpole	Weekday Morning	0.81	33	C	0.76	41	D
	Weekday Evening	0.96	50	D	0.94	61	E
#90 Route 27 at Route 1- Walpole	Weekday Morning	>1.20	>120	F	>1.20	>120	F
	Weekday Evening	>1.20	>120	F	>1.20	>120	F
#91 Old Post Road at Route 1 - Sharon	Weekday Morning	1.00	51	D	1.20	64	E
	Weekday Evening	1.19	68	E	>1.20	90	F
#92 Pine Street at Route 1 - Walpole	Weekday Morning	0.88	23	C	1.15	65	E
	Weekday Evening	0.95	31	C	>1.20	84	F
#93 Water Street at Route 1 - Foxborough	Weekday Morning	1.04	43	D	1.11	73	E
	Weekday Evening	>1.20	99	F	>1.20	>120	F
#94 Patriot Place at Route 1 - Foxborough	Weekday Morning	0.28	4	A	0.68	14	B
	Weekday Evening	0.67	8	A	0.90	52	D
#95 Pine Street at Route 1 - Foxborough	Weekday Morning	0.67	15	B	0.91	28	C
	Weekday Evening	0.74	20	B	1.11	81	F

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.

Table 3-17 Signalized Intersection Capacity Analysis Summary

		2008 Existing Conditions			2030 Baseline Conditions		
Intersection	Time Period	V/C[1]	Delay[2]	LOS[3]	V/C[1]	Delay[2]	LOS[3]
#97 Thurston Street at Route 1 - Wrentham	Weekday Morning	0.74	10	A	0.86	20	C
	Weekday Evening	0.50	6	A	0.74	14	B
#99 Taunton Street at Route 1 (Washington Street) - Plainville	Weekday Morning	0.59	15	B	0.85	40	D
	Weekday Evening	0.56	18	B	0.69	26	C
#100 Route 106 at Route 1 - Plainville	Weekday Morning	0.65	22	C	0.83	34	C
	Weekday Evening	0.75	24	C	0.92	41	D
#101 Elmwood Street at Route 1 - N. Attleboro	Weekday Morning	0.94	46	D	0.92	39	D
	Weekday Evening	>1.20	57	E	1.12	78	E
#102 Fisher Street at Route 1 - N. Attleboro	Weekday Morning	0.39	6	A	0.48	7	A
	Weekday Evening	0.47	6	A	0.61	7	A
#103 Orne Street at Route 1 - N. Attleboro	Weekday Morning	0.65	14	B	0.78	17	B
	Weekday Evening	0.60	12	B	0.73	15	B
#104 Elm Street at Route 1 - N. Attleboro	Weekday Morning	0.72	17	B	0.93	33	C
	Weekday Evening	1.01	61	E	>1.20	>120	F
#105 Chestnut Street at Route 1 - N. Attleboro	Weekday Morning	0.34	12	B	0.45	13	B
	Weekday Evening	0.74	18	B	1.01	45	D
#106 Draper Avenue at Route 1 - N. Attleboro	Weekday Morning	0.49	17	B	0.57	20	C
	Weekday Evening	0.65	21	C	0.85	30	C
#107 Allen Avenue at Route 1 - N. Attleboro	Weekday Morning	0.35	12	B	0.38	12	B
	Weekday Evening	0.81	38	D	0.93	45	D
#108 Cumberland Avenue at Route 1 - N. Attleboro	Weekday Morning	0.34	9	A	0.38	9	A
	Weekday Evening	0.70	16	B	0.69	18	B
#109 May Street at Route 1 - Attleboro	Weekday Morning	0.44	16	B	0.48	17	B
	Weekday Evening	0.66	20	C	0.75	25	C
#110 Route 1A /driveway at Route 1 - Attleboro	Weekday Morning	0.50	12	B	0.53	12	B
	Weekday Evening	0.66	27	C	0.71	31	C
#111 Route 123 at Route 1 - Attleboro	Weekday Morning	0.70	51	D	0.54	29	C
	Weekday Evening	1.16	>120	F	0.97	60	E
#112 Brown Street at Route 1 - Attleboro	Weekday Morning	0.36	9	A	0.40	9	A
	Weekday Evening	0.56	11	B	0.63	13	B
#113 Mendon Road at Route 1 - Attleboro	Weekday Morning	0.30	7	A	0.34	8	A
	Weekday Evening	0.38	6	A	0.43	6	A
#114 Bacon Street at Route 1 - Attleboro	Weekday Morning	0.62	20	C	0.68	25	C
	Weekday Evening	0.86	26	C	0.95	36	D
#116 Hoppin Hill Avenue at Route 1 - N. Attleboro	Weekday Morning	0.75	66	E	0.91	105	F
	Weekday Evening	0.91	52	D	1.13	92	F

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. V/C ratios range from 1.0 when demand equals capacity to 0 when demand is zero. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.

Table 3-18 Unsignalized Intersection Capacity Analysis Summary

		2008 Existing Conditions								2030 Baseline Conditions							
		Weekday Morning				Weekday Evening				Weekday Morning				Weekday Evening			
Intersection	Critical Movement(s)	v/c[1]	Del[2]	LOS[3]	Q[4]	v/c	Del	LOS	Q	v/c[1]	Del[2]	LOS[3]	Q[4]	v/c	Del	LOS	Q
#85 Dean Street at Route 1 SB off-ramp	NB LT-TH-RT	0.25	26	D	24	0.68	65	F	98	*Location Signalized – See Table 3-17*							
	SB LT	1.05	>120	F	212	>1.20	>120	F	364								
#85 Dean Street at Route 1 NB off-ramp	NB LT-RT	0.85	53	F	196	1.17	>120	F	462	*Location Signalized – See Table 3-17*							
#96 East Street at Route 1	EB RT	0.09	10	B	7	0.36	23	C	40	0.11	12	B	10	1.02	>120	F	175
	WB RT	0.77	46	E	152	0.24	11	B	23	>1.20	Err	F	Err	0.49	18	C	66
#98 Madison Street at Route 1	EB LT-TH-RT	0.25	20	C	24	0.61	58	F	82	>1.20	>120	F	205	>1.20	Err	F	Err
	WB LT-TH-RT	>1.20	>120	F	131	>1.20	>120	F	181	Err	Err	F	Err	Err	Err	F	Err

Source: VHB, Inc. using Synchro 7 (Build 763) software.
1 V/C – Volume-to-capacity ratio. Values over 1.0 indicate demand in excess of capacity.
2 Delay – Control delay per vehicle, expressed in seconds, includes initial deceleration delay, queue moe-up time, stopped delay, and final acceleration delay.
3 LOS – Level-of-Service. LOS A indicates free flow conditions with minimal delays. LOS E and F indicate congested conditions.
4 Q – 95th percentile queue length estimate, in feet.
NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound; LT = left-turn; TH = through; RT = right-turn

3.7 Issues Definition and Evaluation

Chapter 3 has presented the future transportation conditions within the study area. As would be expected, many of the existing deficiencies/needs that were presented in Chapter 2 are negatively impacted as traffic demands increase to the 2030 design conditions. Several mainline segments, ramps, and study area intersections degrade to "over capacity" levels in the 2030 Baseline Condition. A summary of the existing and future traffic demands, safety assessment, traffic operations, and geometric deficiencies is presented below.

3.7.1 Traffic Demands

From 2008 to 2030, daily traffic volumes on I-95 are expected to increase by an average of 9.8 percent - about 0.4 percent per year. In general, higher growth is expected from Exit 9 (Route 1) to Exit 12 (I-93/Route 128). This higher growth can be attributed to a shift in traffic volumes from Route 1 to I-95 due to a more efficient interchange with I-93/Route 128 and increased capacity along I-95/Route 128 that will be provided in the future. From 2008 to 2030, daily traffic volumes on I-495 are expected to increase more significantly by an average of 20.4 percent - about 0.8 percent per year.

Although the magnitude of traffic demand is expected to increase from 2008 to 2030, the patterns exhibited by 2030 are generally unchanged from 2008. Traffic flow is distributed toward Boston (northbound) in the morning and from Boston (southbound) in the evening.

3.7.2 Safety Assessment

A detailed safety analysis was conducted for the I-95, I-495 and Route 1 corridors within the study area limits and is summarized in the Safety Assessment section of Chapter 2. This review was conducted to determine if the traffic demands being placed on the roadways combined with the geometric conditions of the roadways or ramps have resulted in potential safety concerns. It would be expected that, in lieu of any changes to the current geometric conditions, that crash rates would remain unchanged moving into the future conditions.

Vehicular Crash History

To identify potential vehicle crash trends in the region, reported vehicular crash data for the study area roadways and intersections was obtained from MassDOT for the years 2004 through 2006, the most recent three-year history available.

For the mainline segments and interchanges, these data were summarized and crash trends were identified. For the study area intersections along the local roadway networks and Route 1, crash rates were calculated and compared to average crash rates for the area. Crash rates that exceed MassDOT's average for crashes at intersections in the district in which the town or city is located (District 4 or District 5 for study area intersections) could indicate safety or geometric issues for a particular intersection and warrant further examination.

The results of this effort indicate that the following occurred between 2004 and 2006 within the study area:

- There were 313 crashes reported along the I-95 mainline, including nine fatalities
- There were 1,132 crashes reported at the I-95 interchanges, including seven fatalities
- There were 91 crashes reported along the I-495 mainline, including four fatalities
- There were 279 crashes reported at the I-495 interchanges, including one fatality (These results do not include the interchange with Exit 13 (I-95) as these crashes have been reported above)
- Eight out of 15 of the I-95/I-495 study area intersections had crash rates that exceeded the statewide average for the area
- 18 out of 36 of the Route 1 study area intersections had crash rates that exceeded the statewide average for the area
- At the study area intersections, there were a total of three fatal accidents over the three-year period
- Eight study area intersections are on the 2004-2006 Statewide top 200 intersection crash list

Roadside Safety Audit

As part of an unrelated study conducted by MassDOT for the I-95 corridor, a Roadside Safety Audit was conducted along the southern portion of I-95 south of I-495. This effort focused on roadside clearances, crash tendencies, and summarized likely causes and influences of these crash trends.

The study found that there are a number of cross-median crashes occurring along certain sections of the corridor and presented several possible solutions for consideration. These will be explored in the development of the alternatives in the future sections of this report.

3.7.3 Traffic Operations

A comparison of Figures 2-13 through 2-51 (existing conditions) to Figures 3-5 through 3-43 (future conditions) graphically illustrates how the projected 2030 scenario worsens in comparison to existing operations. The operational problems identified in the existing conditions are exacerbated in the future condition analyses. Also, the growth in traffic volumes is projected to result in additional operational issues throughout the study area.

As presented above, LOS E/F operations are projected during one or both peak periods for:

- **I-95:** 18 of the 26 mainline segments; 44 of the 60 ramp merge/diverge areas; and six of the ten weave areas
- **I-495:** none of the 12 mainline segments; 5 of the 25 ramp merge/diverge areas; and one of the six weave areas
- **I-95/I-495**: Three of the 17 signalized intersections; and 16 of the 22 unsignalized intersections
- **Route 1:** 17 of the 35 signalized intersections; and 4 of the four unsignalized intersections

Under LOS E conditions, the facility is operating at its capacity. At LOS F, the facility is operating under "forced flow" conditions. LOS E and F are both considered to be unstable conditions where the slightest disruption in traffic flow will result in congested conditions.

Table 3-19 compares the volume to capacity (v/c) ratios and levels-of-service (LOS) that currently exist during morning and evening peak hours for the I-95 mainline to those that are projected for the 2030 Baseline Conditions. As shown, during the morning peak hour, four of the 13 I-95 northbound segments will continue to operate under congested conditions (LOS E/F). Five additional segments are projected to degrade to LOS E/F in the 2030 Baseline Conditions from acceptable LOS D in the 2008 Existing Conditions. Of these nine segments, five segments are projected to operate over capacity with v/c ratios greater than 1.00. Along I-95 southbound during the evening peak hour, four of the 13 segments of I-95 southbound continue to operate under congested conditions (LOS E/F). Five additional segments are projected to degrade to LOS E/F in the 2030 Baseline Conditions from acceptable LOS D in the 2008 Existing Conditions. Of these nine segments, four segments are projected to operate over capacity with v/c ratios greater than 1.00.

Table 3-19 I-95 Freeway Segment Capacity Analyses Comparison

	I-95 Northbound						I-95 Southbound				
	2008 Existing		2030 Baseline				2008 Existing		2030 Baseline		
Segment	v/c	LOS	v/c	LOS	LOS Change	Segment	v/c	LOS	v/c	LOS	LOS Change
Rhode Island to Exit 1						Exit 12 to Slip Ramp					
AM	0.57	C	0.62	C	-	AM	0.47	B	0.56	C	B-C
PM	0.52	C	0.57	C	-	PM	0.82	D	0.98	E	D-E
Exit 1 to Exit 2						Slip Ramp to Exit 11					
AM	0.62	C	0.67	C	-	AM	0.48	B	0.59	C	B-C
PM	0.55	C	0.61	C	-	PM	0.97	E	1.16	F	E-F
Exit 2 to Exit 3						Exit 11 to Exit 10					
AM	0.65	C	0.69	C	-	AM	0.48	B	0.56	C	B-C
PM	0.51	C	0.55	C	-	PM	0.96	E	1.09	F	E-F
Exit 3 to Exit 4						Exit 10 to Exit 9					
AM	0.68	C	0.72	D	C-D	AM	0.42	B	0.48	B	-
PM	0.50	B	0.54	C	B-C	PM	0.87	D	0.98	E	D-E
Exit 4 to Exit 5						Exit 9 to Exit 8					
AM	0.89	D	0.96	E	D-E	AM	0.44	B	0.49	B	-
PM	0.65	C	0.71	D	C-D	PM	0.93	E	1.03	F	E-F
Exit 5 to Exit 6						Exit 8 to Exit 7					
AM	0.96	E	1.04	F	E-F	AM	0.48	B	0.51	C	B-C
PM	0.63	C	0.70	C	-	PM	0.89	D	0.97	E	D-E
Exit 6 to Exit 7						Exit 7 to Exit 6					
AM	0.94	E	1.02	F	E-F	AM	0.48	B	0.52	C	B-C
PM	0.53	C	0.59	C	-	PM	0.88	D	0.96	E	D-E
Exit 7 to Exit 8						Exit 6 to Exit 5					
AM	0.93	E	1.01	F	E-F	AM	0.59	C	0.63	C	-
PM	0.53	C	0.60	C	-	PM	0.93	E	1.02	F	E-F
Exit 8 to Exit 9						Exit 5 to Exit 4					
AM	0.95	E	1.05	F	E-F	AM	0.60	C	0.64	C	-
PM	0.50	C	0.57	C	-	PM	0.89	D	0.96	E	D-E
Exit 9 to Exit 10						Exit 4 to Exit 3					
AM	0.82	D	0.95	E	D-E	AM	0.46	B	0.48	B	-
PM	0.48	B	0.60	C	B-C	PM	0.60	C	0.64	C	-
Exit 10 to Exit 11						Exit 3 to Exit 2					
AM	0.87	D	1.03	F	D-F	AM	0.47	B	0.50	C	B-C
PM	0.54	C	0.67	C	-	PM	0.56	C	0.60	C	-
Exit 11 to Slip Ramp						Exit 2 to Exit 1					
AM	0.78	D	0.97	E	D-E	AM	0.51	C	0.55	C	-
PM	0.51	C	0.68	C	-	PM	0.54	C	0.58	C	-
Slip Ramp to Exit 12						Exit 1 to Rhode Island					
AM	0.78	D	0.94	E	D-E	AM	0.50	C	0.53	C	-
PM	0.51	C	0.65	C	-	PM	0.51	C	0.55	C	-

3.7.4 Geometric Deficiencies

A detailed evaluation of each of the various interchanges and mainline components of the I-95 and I-495 study corridors was completed and has been summarized in the Transportation Infrastructure Review section of Chapter 2. The section highlights both current design standards as well as locations where the design standards are currently either deficient or need additional evaluation.

The results of this assessment indicate the following deficiencies along the corridor:

- Left and right shoulder widths are inadequate along the I-95 and I-495 mainline.
- A minimum 30 ft clear zone is not consistently provided along the right side of the freeway.
- The rate of vertical curvature (Ka) along the I-95 and I-495 mainline consistently does not meet the design criteria for 70 mph, resulting in sight distance issues throughout these corridors.
- Ten bridges throughout the study area do not meet the MassHighway standard of 16 ft 6 in vertical clearance.
- Several instances of interchanges along the corridor were identified where the current layout does not meet the current design guidelines.

A review of the numerous bridges in the study area that are routinely inspected by MassDOT using National Bridge Inspection Standards (NBIS) was conducted. The results of this investigation include:

- According to MassDOT there are three structurally deficient bridges in the study area
- There are no functionally obsolete bridges in the study area, according to MassDOT.

The information summarized above is not only intended to identify current roadway design issues but will also be instrumental ultimately in determining which roadway segments and intersections should be more closely examined as part of the development of future recommendations for the corridor.

4

Alternatives Development and Analysis

As documented by the existing conditions analysis, congestion and safety deficiencies exist along many of the mainline segments, interchanges and local intersections within the I-95 study area. In addition, many of these operational and safety deficient locations identified under the existing conditions assessment will only be exacerbated in the future. Despite an on-going program of planned improvements in the region, there are still many locations within the study area that are projected to operate at or over capacity if left unchanged by 2030.

Once the existing and future deficiencies were defined, a series of ideas aimed at addressing the area's transportation problems were developed. Through a series of outreach meetings and discussions with local officials, approximately 175 concepts were considered. Of those, several were outside of the scope of this effort, some were not expected to address the core goals and objectives of this project, and some were very similar in nature to other ideas presented. After reviewing them all, the list of 175 alternatives were condensed into about 120 alternatives for consideration. The 120 alternatives were further broken down into short-term, medium-term, and long-term actions and then were evaluated and screened. For any ideas to be viable, they needed to be consistent with the goals and objectives originally set forth in this project. This chapter describes the various alternatives explored, and how they met the goals and objectives outlined at the outset of this project.

4.1 Alternatives Development and Analysis Methodology

A range of alternatives was developed through the study process to address the defined existing and projected deficiencies/needs in the study corridor. These alternatives were developed through collaborative working sessions with MassDOT Highway Division, the Working Group, the Study Advisory Group, the consultant team, community representatives, and the general public. Each alternative was evaluated to assess how well it met the study goals and objectives. The alternatives development and analysis process are described in this section of the report.

4.1.1 "Top 10" Route 1 Intersection Selection

The Route 1intial study area included 36 intersections from the Providence Highway at Route 109/Bridge Street intersection on the Boston city line in the north to the Route 1 at Bacon Street intersection just north of the Rhode Island/Massachusetts State Line in the south. As part of the Existing and Future conditions assessments, an evaluation of the safety conditions and traffic operations was completed for each of the 36 Route 1 intersections and has been presented previously. Based on these evaluations and the scope of the effort being conducted, the following 10 intersections along Route 1 were selected for further study and alternatives development:

- #111 Route 1 at Route 123 (Attleboro)
- #101 Route 1 at Route 1A/Elmwood Street (North Attleborough)
- #96 Route 1 at East Street (Foxborough- unsignalized)
- #90 Route 1 at Route 27 (Walpole)
- #89 Route 1 at Coney Street (Walpole)
- #85 Route 1 at Dean Street (Norwood)
- #83 Route 1 at Everett Street (Norwood)
- #82 Route 1 at Elm Street (Dedham)
- #81 Route 1 at Eastern Avenue (Dedham)
- #80 Route 1 at Washington Street (Dedham)

The evaluation and selection process for the Route 1 intersections is outlined a memorandum included in the Appendix.

4.1.2 Alternatives Evaluation

The actual evaluation of the various alternatives was separated into two portions: the transportation evaluation and the environmental evaluation.

The impacts of each alternative on traffic operations and safety were evaluated based on the 2030 Baseline weekday morning and evening traffic volumes. Where appropriate, shifts to future traffic demands under the various alternatives were considered. The Statewide Travel Demand Model for this study was utilized, where appropriate, to determine the future traffic demands under some of the various alternatives considered. Analyses were conducted for each alternative during the weekday morning and evening peak hours to assess the operational benefits when compared to the 2030 Baseline condition and other potential alternatives.

An environmental review was completed to evaluate and compare potential environmental impacts for each alternative. The environmental constraints identified and mapped in earlier tasks were overlaid with the proposed alternatives to determine impacts in each of the environmental review categories. In this way, each alternative's

relative impacts were able to be compared. The environmental impact analysis focused on the following categories of impacts:

- **Land Use/Right-of-Way** - The potential land use impacts associated with each of the alternatives were reviewed. The review included a general description of the affected communities/neighborhoods and municipalities and public facilities.
- **Wetlands & Surface Water Resources** - Each alternative was overlaid onto the wetland mapping to determine impacts to wetland resources.
- **Outstanding Resource Waters and Critical Areas** - The proposed alternatives were reviewed to determine if they are within 500 feet of any public drinking water resources.
- **Cultural Resources** - Each alternative was reviewed to determine if it would have an impact on historic or archaeological resources listed in, or eligible for inclusion in, the state or National Register of Historic Places. This effort focused on selected areas where improvements are outside of the I-95, I-495, or Route 1 right-of-way.
- **Section 4(f) and Section 6(f) Lands -** Whether an alternative would affect any Section 4(f) or Section 6(f) properties was determined on a preliminary basis, and the potential impacts including land, facilities and functions that would be affected were described. Again, this effort focused on selected areas where improvements are outside of the I-95, I-495, or Route 1 right-of-way.
- **Natural Heritage and Endangered Species Program (NHESP)** - A preliminary analysis of the various ecological communities within the study area was conducted to determine if any rare species are present and would be affected by the proposed alternatives.
- **Vernal Pools** - A preliminary analysis of the potential vernal pools within the study area was conducted to assess impacts of the proposed alternatives.
- **Socioeconomic Environment/ Environmental Justice** - Executive Order 12898 requires that federal actions avoid disproportionate adverse effects to disadvantaged groups to the extent practicable. As such, each alternative was reviewed to determine if it would adversely impact any minority or low income population.

The next step in the alternatives analysis process included conducting an evaluation based on the study goals:

- Improve traffic flow on freeways, ramps and local streets in the study area
- Improve safety for all modes of transportation within the study area
- Improve mobility and transportation choice
- Meet transportation goals while minimizing impacts to the quality of life for area communities
- Protect and enhance the natural and cultural environment
- Develop recommendations that can be implemented efficiently
- The study will continue to be conducted through an open and inclusive process
- Recommendations should address demonstrated needs

The potential overall effectiveness of each of the alternatives for each location (mainline segment, interchange, intersection) were evaluated and compared with the expected impacts to determine the feasibility of implementation and the potential to achieve the goals and objectives of the study. This effort identified each alternative's ability to satisfy the evaluation criteria and address long-term needs. A matrix evaluation was used for this process and is documented in the Appendix. The results of the screening were presented to the Working Group for input and concurrence on the results.

The results of this detailed evaluation were ultimately used to develop a preferred short-, medium-, and long-term alternative recommendation plan for the entire study area. This recommendation plan is presented in Chapter 5.

4.2 Transportation Demand Management Applications

As a general practice, there are two effective mean of addressing capacity related issues. One option is to increase the capacity of a specific transportation element. Another option is to reduce the demand of the traffic utilizing the transportation element. Transportation demand management techniques target the latter by seeking to improve the efficiency of transportation resources.

This section, therefore, seeks to identify policies and strategies geared towards reducing the number of vehicles on the roadway. Strong public support was vocalized at the public meetings for implementing TDM measures as a first step – or at least a complimentary step – to expanding the capacity of certain transportation resources. This section, therefore, discusses the various components that could be implemented which would reduce the vehicle demand on study area roadways.

These transportation demand management (TDM) options focus on lower-cost actions that could address identified deficiencies within the study area without structural or geometric improvements to the existing infrastructure. The TDM alternatives are categorized as follows:

- Park and Ride Locations
- Transit Improvements
- Pedestrian/Bicycle Improvements
- Intelligent Transportation Systems
- Access Management

Many of these services are provided by MassRIDES, a service of MassDOT that was represented on the SAG.

Furthermore, local municipalities should consider more inclusive policies for future land use proposals and transportation improvement actions, while respecting the rights of landowners. These might include a careful review of current zoning along the Route 1 corridor as well as near the I-95 interchange system that would encourage mixed-use

developments and would take advantage of the proximity to these unique transportation corridors.

4.2.1 Park and Ride Locations

To supplement the commuting options, Park and Ride locations provide drivers with an opportunity to meet and consolidate their trips into one vehicle. For this reason, park and ride locations were considered at several key points throughout the study area. It should be noted that there are currently no official Park and Ride locations within the study area along I-95, I-495, or Route 1.

Park and Ride lot users are generally assumed to be intercept users (the lot is conveniently located between their origin and destination), casual users (people meeting and carpooling occasionally), or transit users (people taking direct transit connections from the lot to their final destination). All locations considered needed to be positioned to attract and/or intercept casual users from the I-95 and/or Route 1 corridors. Each location considered is either a safe and convenient location for people coming from different directions to meet and carpool to their final destination, and/or a direct or close connection to the I-95 corridor.

The introduction of Park and Ride lots would need to be accompanied by several incentives to increase ridesharing potential. These incentives could include:

- Advertising
- Education
- Ridematching services
- Preferential parking
- Secure parking
- Free or Discounted parking rates
- Guaranteed ride home services
- Transit coordination

After considering numerous locations and through discussions with the MassDOT Park and Ride coordinators, several locations were considered for Park and Ride lots along the corridor. They are described in detail below.

I-95 Exit 5 – Toner Boulevard/Route 152

Two locations were considered for Park and Ride lots in the vicinity of this interchange. A Park and Ride lot in this location could provide direct access for commuters to I-95 and to GATRA bus services.

Triboro Plaza Parking Lot

The first location considered was the Triboro Plaza movie theater parking lot located along Dietsch Boulevard. The advantage to this location is that a parking lot already exists; significant modifications would not be necessary to utilize the lot as a Park and Ride facility. However, constructing a Park and Ride lot at this location would require coordination with the private land owners.

Toner Boulevard

The second location considered was vacant land in the southwest quadrant of the I-95 interchange along Toner Boulevard. This location could provide direct access to Toner Boulevard opposite John Dietsch Boulevard. To accomplish this, signal upgrades would be required. A lot at this location would also require potential right-of-way takings and parking lot construction. This location is adjacent to an existing neighborhood located along Commonwealth Avenue.

I-95 Exit 9 – Route 1

Two locations were considered for Park and Ride lots in the vicinity of this interchange. A Park and Ride lot in this location could provide direct access for commuters to Route 1 and I-95.

Route 1 Southbound

The first location considered was vacant land along Route 1 southbound, north of its interchange with I-95. A lot at this location would require potential right-of-way takings and parking lot construction. It should be noted that constructing a Park and Ride lot at this location would require lot users that travel to the north to u-turn at an adjacent traffic signal or within the I-95 Exit 9 ramp system.

Route 1 Northbound

The second location considered was along Route 1 northbound, between Old Post Road and the I-95 interchange. The advantage to this location is that a parking lot already exists although significant modifications would not be necessary to utilize the lot as a Park and Ride facility. It should be noted that constructing a Park and Ride lot at this location would require coordination with the private land owners. Access to this location would be provided via the Route 1 at Old Post Road intersection.

4.2.2 Transit Improvements

As noted in prior sections, there are several transit options available to the region's commuters and travelers. This section outlines opportunities to enhance those existing services through a number of techniques.

It should be noted that all transit alternatives developed as part of this study may be precluded by the selection of a South Coast Rail preferred alternative. The South Coast Rail project is being conducted by MassDOT and seeks to restore passenger rail transportation from South Station in Boston to the cities of Fall River and New Bedford. The project would

utilize an existing freight rail corridor running south from Taunton to Fall River and New Bedford. At the time of this draft, the scope of environmental review has been narrowed to three alternatives: rail via Attleboro, rail via Stoughton and a Rapid Bus alternative. MassDOT is currently studying the three options, along with a No Build option, in its draft state and federal environmental impact documents. The selection of a preferred alternative will not be final until the final environmental documents are filed in spring of 2010[9].

While the South Coast Rail project is going through its environmental process, there are a number of other transit-oriented options that were also considered as part of the I-95 South project. They include increasing trip frequency, improving connections, decreasing travel times, adding new routes, and improving transit station parking and access. Obviously, the South Coast Rail effort may provide the opportunity for additional connections and a more robust transit platform from which specific recommendations could be enhanced. With this in mind, the specific transit improvements considered are described in detail below.

MBTA/GATRA Bus Improvements

There are two main bus service providers in the I-95 South Corridor area: the Massachusetts Bay Transportation Authority (MBTA) and the Greater Attleboro Taunton Regional Transit Authority (GATRA). The MBTA provides bus service to study area communities of Walpole, Norwood, Westwood, Dedham, and Canton. In the study area, GATRA provides fourteen fixed routes, two intercity routes and a "Dial-A-Ride" program to the towns of Attleboro, North Attleborough, Plainville, Mansfield, Foxborough and Wrentham.

Several improvement strategies were considered for bus routes throughout the study area including:

- Route 1 transit signal priority
- Route 1 express bus with signal preemption
- Increased bus service to shopping malls
- Increased headways and routes for north-south bus service
- Explore expanded fixed-route, intercity bus route service opportunities in the GATRA region

MBTA Commuter Rail Improvements

The MBTA commuter rail has three lines that connect South Station in Boston with study area municipalities. The Providence/Stoughton line has two branches with seven stations in five study area communities including Attleboro, Mansfield, Sharon, Canton, and Westwood. The Franklin line has eight stations in four study area communities including Walpole, Norwood, Westwood, and Dedham.

9 http://www.southcoastrail.com/

Commuter Rail Service

Several improvement strategies were considered to enhance commuter rail service throughout the study area including:

- Explore ability to increase commuter rail frequency on congested corridors
- Upgrade Foxborough to a full-time station

Commuter Rail Parking and Access

At outreach meetings, several communities in the study area noted that MBTA commuter rail parking facilities reach capacity early on a typical weekday and are generally unable to accommodate parking demands – therefore limiting the ridership of the commuter rail services when these lots are full. Additionally, access to several of the study area commuter rail stations was noted as problematic (Mansfield and Attleboro stations specifically). Several improvement strategies were considered to enhance access to and parking at the commuter rail stations throughout the study area including:

- Explore shuttle service from business centers to commuter rail stations
- Explore and develop improved directional signage for station locations off of the I-95 corridor as well as parking locations supporting those stations.
- Assess the commuter rail parking and access issues at all of the commuter rail stations along the corridor – particularly the Mansfield and Attleboro stations.

4.2.3 Pedestrian/Bicycle Improvements

While not expected to have a measurable effect on study area traffic operations due to the long distance nature of trips, improvements were considered to enhance pedestrian and bicycle connectivity and safety. The following general improvement options were considered to address existing deficiencies:

- Encourage each community to develop a comprehensive Sidewalk Plan connecting business centers with possible pedestrian generators;
- Consider sidewalk installation to fill in gaps along Route 1 and near I-95 interchanges;
- Develop sidewalk maintenance plans;
- Develop crosswalk striping/maintenance plans;
- Provide a consistent shoulder so that bicyclists can utilize the major corridor study links;
- Assess pedestrian accommodations at signalized intersections;
- Assess pedestrian accommodations at school bus pick-up/drop-off locations along Route 1

It should be noted that the recommendations presented above are intended to address pedestrian and bicycle deficiencies along Route 1and along the local roadways in the vicinity of the I-95 and I-495 interchanges. No pedestrian or bicycle accommodations are proposed along the interstate highway system mainline or ramps. Pedestrians and bicycles are prohibited from the interstate highway system, except in the case of emergencies such as a disabled vehicle or crash. In these cases, pedestrians should

remain in the provided shoulder or clear zone. It should be noted that alternatives were developed not to preclude bicycle/pedestrian operations,

4.2.4 Intelligent Transportation Systems

The potential short- and long-term mainline alternatives presented for the I-95 corridor present various opportunities for Intelligent Transportation System (ITS) Technology deployments. These deployments would build upon the existing ITS infrastructure along the I-95 corridor presented earlier and in some cases upgrade the portable devices currently deployed.

The potential field equipment and locations identified for new ITS deployments represent an ultimate build-out condition, without constraints such as funding, scheduling, programming, and equipment interdependencies. Locations were selected balancing appropriate coverage of the corridor and dispersion of equipment while minimizing information overload to the drivers.

Dynamic Message Signs (DMS)

To influence route selection, DMS could be placed at points along the corridor where the drivers have opportunity to respond to the information disseminated and can adjust their routes to account for the information received. These signs should be installed along freeway segments with minimal external distractions and should be visible for 2000 feet or more to provide maximum visibility and message retention, particularly for multi-screen messages. DMS are also a tool used in the dissemination of child abduction alerts, also known as Amber Alerts.

The preliminary step in the deployment of permanently mounted DMS for the corridor included a review of the existing Portable Variable Message Sign (PVMS) locations currently deployed. The existing PVMS could then be deployed elsewhere to supplement the permanent DMS locations or used as part of the traffic control during construction within the corridor. The candidate locations for permanently mounted DMS include:

- **DMS-95.01-** I-95 Northbound prior to the I-295 interchange. This DMS would be the first DMS travelling northbound on I-95 from Rhode Island and would serve to provide motorist related traveler information, potential diversionary route information or amber alerts.
- **DMS-95.02** – I-95 Northbound prior to the I-495 interchange. This DMS would provide motorist related traveler information along I-495, potential diversionary route information and potential event related congestion like that from the Wrentham Village Outlet/Comcast Center congestion.
- **DMS-95.03** – I-95 Northbound prior to Exit 9-Route 1/Route 27. This DMS would provide potential diversionary route information in case it would be necessary to divert traffic onto the adjacent Route 1 corridor and occasional event related information related to Gillette Stadium.
- **DMS-95.04** - I-95 Northbound south of the Route 128/Route 95 interchange. The northbound DMS would provide motorist related traveler information related to the major interchange, amber alert information and major diversionary routing information around the Boston area.
- **DMS-95.05** – I-95 Southbound prior to Exit 9 – Route 1. This DMS would provide diversionary routing onto Route 1 southbound as well as provide event related information for Gillette Stadium.
- **DMS-95.06** – I-95 Southbound prior to I-495 interchange. This DMS would provide motorist related traveler information along I-495, potential diversionary route information and potential event related congestion like that from the Wrentham Village Outlet/Comcast Center congestion.
- **DMS-95.07** – I-95 Southbound prior to the I-295 interchange. This DMS would provide motorist related traveler information along I-295, potential diversionary route information and potential airport related congestion.

Microwave Vehicle Detection System (MVDS)

The I-95 corridor could benefit from a Microwave Vehicle Detection System (MVDS). The MVDS includes individual vehicle detectors and an algorithm that recognizes significant changes between detectors. The individual detectors record vehicle presence, traffic volume, lane occupancy and average speed information. Rapid changes in these freeway characteristics can highlight a problem along the corridor. The algorithm compiles the data from each of the detectors and may trigger an alarm or a preprogrammed response if the detector data reach predetermined thresholds.

Typically, MVDS deployments are based on a spacing of between ⅓ and ½ mile. With calibrated algorithms, this spacing criterion provides enough information to monitor trends in the traffic stream. For freeways such as I-95, a spacing of 1,800 to 3,000 feet is typical. Long tangent segments of freeway are conducive to greater spacing between detectors while freeway segments with regularly spaced interchanges and curves benefit from more frequent MVDS placement.

In order to provide adequate coverage for incident detection, it is proposed to install MVDS units at regularly spaced intervals along the study corridor.

Closed Circuit Television Cameras (CCTV)

The closed circuit television camera (CCTV) has proven over the years to be an important tool in the implementation of intelligent transportation systems. The camera assembly can provide visual verification of incidents as well as a means to provide detailed information for incident response. The cameras can also be used to supplement other devices such as verifying messages on DMS and variable speed limit signs. Current

technology allows camera views of 3,500 to 5,000 feet with sufficient detail to view traffic conditions. To achieve these viewing distances, it is recommended to install the camera on a pole with a mounting height of about 60 feet above the roadway surface.

For ease of maintenance, it would be recommended that all CCTV camera locations be equipped with lowering devices. The lowering devices, typically a winch system, allow the cameras to be lowered to ground level for easy maintenance. Without a lowering device, camera maintenance would require maintenance personnel to be lifted to the camera height for access. The typical lowering device is mounted external to the support pole.

Since the information obtained from CCTV cameras can be valuable to ITS operators, many ITS systems are deployed with the goal of full camera coverage. Full camera coverage would allow for the highest level of comfort in the ability to detect and verify incidents along the corridor in a timely manner. The real time information on traffic conditions can be essential in properly managing the daily operations of the corridor as a whole. However, full camera coverage can become cost prohibitive along curving roadways and in areas where trees overhang the shoulder and roadway. For the I-95 corridor, it is proposed that cameras are installed at major interchanges along the corridor. It is estimated that approximately five major interchange locations would benefit from monitoring.

- **CCTV-95.01** - I-95 at the Rhode Island Border - The view of this camera is expected to cover the Rhode Island state line.
- **CCTV-95.02** - I-95 at the I-295 interchange – This camera location would provide views of the I-295 interchange area.
- **CCTV-95.03** - I-95 at the I-495 interchange – This camera location would provide monitoring capability of one of the most highly traveled areas in New England.
- **CCTV-95.04** - I-95 Northbound at around Exit 9 – Route 1/Route 27 interchange. This camera location would monitor the highly traveled interchange during the New England Patriots games and concerts at Gillette Stadium. This exit is routinely closed during periods of event related congestion.
- **CCTV-95.05** - I-95 south of the Route 128/Route 93 interchange. There are existing CCTV that monitor this interchange but augmenting this coverage with additional views south of the interchange would be beneficial.

Furthermore, the use of dedicated surveillance systems utilizing CCTV cameras has also proven to be a very important security tool over the years. Any cameras installed at critical bridges and infrastructure can utilize the existing communications infrastructure installed on the I-95 corridor to convey security information to the Massachusetts State Police.

Communications Approach

The I-95 corridor has an existing "dark" fiber optic backbone from the I-295 corridor northerly along I-95 to the northern limits of the corridor at the Route 128/I-95 interchange. All of the ITS field devices that are identified for deployment along the corridor could be connected into the fiber optic backbone with the exception of any installed devices south of I-295 (i.e. DMS 95.01 or any MVDS at the RI border). These ITS devices could be connected wirelessly through a microwave link from the device(s) to the existing fiber at I-295. Because of the high capacity of the fiber backbone, bandwidth limitations would likely not be a factor. Further discussions with MassDOT as to their preferred communications architecture would be required.

Traffic Operations Center (TOC)

All of the data collected by the proposed ITS field devices would be transmitted to the MassDOT Highway Operations Center (HOC) in Boston, MA. The purpose of the HOC is to collect and analyze the operational data from the statewide transportation network and provide real-time condition information to the public, first responders, maintenance personnel, and other public agencies.

511 Massachusetts

As described in Chapter 2, 511 Massachusetts service currently covers I-95, I-495, and Route 1 from I-95/Route 128 to I-495 in the study area. Potential short-term improvements to this service include expansion of Route 1 coverage in the study area and to continue to explore increased traffic camera coverage.

4.2.5 Access Management

During outreach meetings, several communities expressed interest in developing access management guidelines for the Route 1 corridor. The following general improvement options should be considered to address access management issues along Route 1:

- Consolidate multiple existing driveways to a single development into one driveway, if possible;
- Amend zoning regulations to incorporate access management desires;
- Median divide certain sections of roadways to prohibit left-turns;
- Consider acceleration/deceleration lanes along certain sections of Route 1; and
- Consider signal installation (with consolidated access)

4.3 Mainline Alternatives

The mainline improvement alternatives focused on addressing geometric deficiencies, improving safety, and relieving congestion on the segments of the I-95 mainline that create bottlenecks during peak hour conditions. The following three I-95 segments either currently operate at or near capacity and are projected to be congested under the 2030 peak hour conditions. For this reason, they were studied for improvement:

- Exit 4 (I-295) to Exit 6 (I-495)
- Exit 6 (I-495) to Exit 9 (Route 1)
- Exit 9 (Route 1) to Exit 12 (I-93/Route 128)

These sections were selected as they represent segments of roadway that can be reasonably grouped together and widened as a whole (as opposed to shorter interchange-to-interchange segments) due to similar travel patterns within the segments (i.e. between major interchanges). Additionally, the entire segment from Exit 4 (I-295) to Exit 12 (I-93/Route 128) was also considered in some cases as noted below. The mainline alternatives are outlined in detail below.

4.3.1 Alternative 1 – Bring Mainline up to Current Design Standards

The first approach to dealing with the mainline segments is to address current deficiencies along the corridor. As noted in prior chapters, there are several pre-existing geometric deficiencies identified along the mainline, including:

- In adequate left and right shoulder widths. A 4-foot left shoulder and 10-foot right shoulder are provided along I-95 throughout the study area. MassDOT design standards require 12-foot left and right shoulders for this facility.
- A minimum 30-foot clear zone should be provided at the right side of the freeway. During field visits, vegetation was observed to be encroaching on the clear zone along much of the corridor; however, MassDOT crews were observed removing vegetation from some overgrown areas.
- The rate of vertical curvature (Ka) along the I-95 mainline consistently does not meet the design criteria for 70 mph, resulting in sight distance issues throughout this corridor.

Additionally, five bridges along I-95 do not meet the MassDOT standard of 16-foot, 6-inch vertical clearance requirement, outlined in Table 4-1.

Table 4-1 Vertical Clearance Deficiencies

Bridge Number	Location	Vertical Clearance
A-16-40	Railroad bridge over I-95, Attleboro	14 ft 3-1/8 in
A-16-41	Bacon Street over I-95, Attleboro	14 ft 3-5/8 in
A-16-51	Clifton Street over I-95, Attleboro	14 ft 1-7/8 in
N-16-47	Robert F. Toner Boulevard over I-95, North Attleborough	16 ft 2 in
F-6-27/M-3-27	I-495 southbound over I-95 southbound, Foxborough	16 ft 3-1/2 in

Addressing mainline geometric deficiencies to meet current design standards was considered and evaluated as an option for the corridor. While addressing all of the deficiencies outlined above would address potential safety issues along the corridor, there would be only a marginal benefit to addressing observed and projected capacity constraints.

That being said, there are a few actions that could be implemented which would have a beneficial impact on safety and capacity. These include:

- Widening the right shoulder from 10-feet to 12-feet
- Widening the left shoulder from 4-feet to 12-feet
- Providing consistent 30-foot clear zone through regular vegetation maintenance
- Incorporating rate of vertical curvature (Ka) adjustments along the I-95 mainline into scheduled resurfacing projects

The actions described above would improve safety along the I-95 corridor by bringing the corridor up to the current design standards. To implement the right and left shoulder improvements, restriping the mainline and widening into the median would be necessary. There are potential bridge reconstruction/ modifications, overhead sign modification, and environmental impacts associated with this widening.

Total costs for this action are estimated to be approximately $415M, exclusive of potential right-of-way acquisitions or utility pole relocation.

4.3.2 Alternative 2 - I-95 Mainline Widening

The first option considered for adding mainline capacity considered constructing an additional fourth general purpose lane along I-95 northbound and southbound. For this alternative it was assumed that the additional lane would be constructed in the median, given the generous, but variable width, section through the majority of the corridor. The final cross-section would include a 12-foot right shoulder, four 12-foot travel lanes, and a 12-foot left shoulder in each direction. A median of varying width, 50 feet (typical) to 490 feet at interchange 9, would continue to divide I-95 northbound and southbound. This proposed cross-section would meet current design standards.

By implementing this widening and adding capacity to the corridor, it was assumed that additional volume would be drawn into the corridor. The Statewide Travel Demand Model was used to identify potential increases in traffic volumes. To assess this impact, four distinct segments were considered:

- Exit 4 (I-295) to Exit 12 (I-93/Route 128)
- Exit 4 (I-295) to Exit 6 (I-495)
- Exit 6 (I-495) to Exit 9 (Route 1)
- Exit 9 (Route 1) to Exit 12 (I-93/Route 128)

Model results indicated that traffic volumes along a widened I-95 could increase by as much as 11.2 percent along certain segments. Additionally, traffic volumes along Route 1 would likely decrease as drivers shifted from one corridor to the other as a result of the extra capacity along I-95. A complete summary of the projected I-95 mainline traffic volumes as a result of this alternative is presented in the Appendix.

The benefits of widening I-95 include improved operations during weekday morning and weekday evening peak hours. Widening the entire section of I-95 from Exit 4 (I-295) to Exit 12 (I-93/Route 128) to four lanes in each direction would result in the following operational improvements:

- Nine segments of I-95 northbound would improve from LOS E/F to LOS D or better in the weekday morning peak hour
- Seven segments of I-95 southbound would improve from LOS E/F to LOS D or better in the weekday evening peak hour; two segments would continue to operate at LOS E
- Ramp operations would improve along the widened corridor due to a decreased proportion of through traffic in the rightmost two lanes

The weekday morning and weekday evening peak hour operational levels of service for Alternative 2 along the I-95 corridor are shown graphically on Figure 4-1.

If a shorter segment of I-95 were to be widened to four lanes, similar operational benefits would be realized in that four lane section. Capacity analysis results for each segment are included in the Appendix for comparison purposes. An additional benefit of this alternative would be improved motorist safety due to the provision of wider shoulders on both the right- and left-sides of the corridor. Finally, a reduction in traffic volumes along the Route 1 corridor would result in improved operations for many of the Route 1 corridor intersections and corridor links.

It should be noted that widening into the median to accommodate the fourth travel lane and widened shoulders in each direction could have the following identified impacts as a result of the widened corridor (which are identified in figures located in the Appendix):

- Needed bridge reconstruction
- Overhead signage modifications
- Environmental impacts

Total costs for this action are estimated to be approximately $750M, exclusive of potential right-of-way acquisitions or utility pole relocation.

4.3.3 Alternative 3 – Provision of a High Occupancy Vehicle Lane

High Occupancy Vehicle (HOV) lanes are open only to vehicles carrying more than one person. These lanes allow HOV to bypass congestion, providing a time savings encouraging more effective use of vehicles, etc. To be successful, HOV lane usage must be carefully balanced. If the lanes are congested there will be little incentive for drivers of single occupancy vehicles (SOV) to consider ride-sharing or bus services. If, the HOV lane is under-utilized, motorists in general use lanes will question the merit of having HOV lanes.

Additionally, the construction of an HOV lane could have an impact on I-95 general purpose lane traffic volumes. The provision of an HOV lane is designed to encourage the formation of carpools and reduce the number of vehicles on the roadway, so potential for a portion of the existing SOV traffic to switch to HOV was also considered. Given the limited travel time savings, the relatively short trip lengths made by commuters within the corridor, the amount of congestion currently present along the majority of the corridor, and diversity of trip destinations at the corridor terminus (i.e. Route 128, I-93, Boston, local destinations), it was determined that there is only marginal incentive for an SOV to switch to HOV and there would be no significant shift in traffic volumes. Furthermore, drivers traveling beyond the I-95 study area corridor would need to re-enter the mainline travel patterns once they reached Route 128 – further reducing its effectiveness. A summary of these calculations is presented in the Appendix. The weekday morning and weekday evening peak hour operational levels of service for Alternative 3 along the I-95 corridor are shown graphically on Figure 4-2.

There are several possible HOV lane configurations including concurrent flow lanes and a single exclusive reversible (contra-flow or "zipper") lane. Due to the nature of the I-95 corridor and the variable median width , the HOV lane alternative considered in this study is the construction of a fourth mainline lane along I-95 in each direction (as opposed to a zipper lane or contra-flow lane). The geometric configuration of the lane was not a factor in the projection of ridership, but for the purposes of analyzing engineering and environmental impacts, a concurrent flow lane adjacent to three general purpose lanes was assumed. It was also assumed that this fourth lane would be restricted to HOV use only during the peak periods. The cross-section would include a 12-foot right shoulder, three 12-foot travel lanes, a 13-foot HOV lane, and a 12-foot left shoulder in each direction. A median of varying width would divide I-95 northbound and southbound. Vehicles would be allowed to access/egress the HOV lane at all interchanges. As noted, this improvement would incorporate widening the existing shoulders to meet current design standards with a wide separation lane between the mainline and HOV lanes (assumed no physical barrier between the lanes)

One criterion for judging the success of an HOV facility is the volume of vehicles and passengers that it would carry. National Cooperative Highway Research Program (NCHRP) Report 414, HOV Systems Manual[10], recommends a minimum operating threshold of 400 to 800 vehicles per hour per lane for freeway HOV lanes. The establishment of a minimum operating threshold is designed to ensure that the facility does not appear to be underutilized to users of the general purpose lanes. The goal is to avoid what is referred to as "empty lane syndrome." To determine the volume of traffic that would utilize an HOV lane, Statewide Travel Demand Model data, previous studies,

10 Report 414, HOV Systems Manual; National Cooperative Highway Research Project, Transportation Research Board; Washington DC 1998

and MassDOT's experiences with the existing I-93 northbound and southbound HOV data were reviewed. Based on these sources, it was estimated that 7.4 percent of the 2030 Baseline traffic volumes currently consist of HOV's. It was assumed that all of these vehicles would utilize an HOV lane in the peak period.

Traffic volumes projected to utilize the HOV lane range from approximately 440 to 490 vehicles along I-95 northbound in the weekday morning peak hour and 450 to 540 vehicles along I-95 southbound in the weekday evening peak hour. Projected peak hour HOV lane volumes are not projected to exceed the 800 vehicle minimum operating threshold on any of the segments in the peak direction. A complete summary of the projected I-95 HOV lane traffic volumes as a result of this alternative is presented in the Appendix.

It should be noted that widening into the median to accommodate the HOV lane and widened shoulders in each direction would have the following identified impacts (which are shown in greater detail in figures located in the Appendix:

- Needed bridge reconstruction
- Overhead signage modifications
- Environmental impacts

Total costs for this action are estimated to be approximately $775M, exclusive of potential right-of-way acquisitions or utility pole relocation.

4.3.4 Alternative 4 – Mainline Breakdown Lane Usage

The use of shoulders, or breakdown lanes, as travel lanes has been in existence in the United States since the late 1960s. More than 24 states (including Massachusetts) have implemented projects involving the use of shoulders as a means of providing additional travel lanes and capacity since that time. Typically, opening shoulder lanes for travel during peak hours is primarily viewed as a temporary solution to peak period congestion until the permanent solutions are constructed.

As outlined in the Existing and Future Conditions chapters, traffic volumes and operations indicate that several segments of I-95 within the study area are currently over capacity and will continue to degrade into the future. This congestion suggests that the corridor could benefit from peak period use of a shoulder lane as a temporary traffic management solution.

It was assumed that, for the purposes of this evaluation, breakdown lane operations would be similar to those currently in place along Route 3 (with travel in the breakdown lane permitted from 6:00 – 10:00 AM and from 3:00 – 7:00 PM only in the peak flow directions).

From a physical perspective, it would be assumed that certain design 'waivers' would be accommodated temporarily so as to avoid major infrastructure investment. Specifically, this would involve restriping a 2-foot left shoulder, a consistent 11-foot breakdown lane, and narrowing the existing three travel lanes to 11-feet to fit within the existing cross-section of pavement. Widening in specific locations would likely be necessary to provide sufficient clear distance from obstacles along the edge of roadway and to provide for emergency vehicle pull-offs (to be spaced at least every ½ mile along the corridor). In addition to the mainline treatment, bridges may need to be widened or modified to provide the necessary highway width to allow traffic to utilize the shoulder as a through lane during peak periods of congestion. It should be noted that the improvement outlined above would not incorporate widening the existing shoulders to meet current design standards.

From a traffic volume perspective, it was assumed that this improvement would not draw a significant volume of additional traffic to the corridor and therefore the 2030 Baseline volumes were used to evaluate this alternative. Use of the breakdown lane would result in improved operations during weekday morning and evening peak hours. During the weekday morning peak hour, six segments of I-95 northbound will improve to LOS D or better; three segments would continue to operate at LOS E. During the weekday evening peak hour, six segments of I-95 southbound will improve to LOS D or better; three segments would continue to operate at LOS E/F. The three segments that would continue to operate at LOS E/F are from the Dedham Street Slip Ramp to Exit 11B, from Exit 11A to Exit 10, and from Exit 9 to Exit 8. The weekday morning and weekday evening peak hour operational levels of service for Alternative 4 along the I-95 corridor are shown graphically on Figure 4-3.

One of the major considerations involved in utilizing the breakdown lane is the impact it has on driver safety. National and Massachusetts-based statistics indicate that there is a clear statistical increase in vehicle crashes associated with the usage of the shoulders as travel lanes. However, as drivers become more familiar with the use of the shoulder as a travel lane, accident rates decline over time (although accident rates universally remain higher than pre-usage periods)[11]

While utilizing the shoulder lane as a means of increasing the capacity of the corridor would help in the near-term, it should be considered very carefully and balanced with the knowledge that there will likely be a statistical increase in vehicle crashes when implemented. Furthermore, this solution should only be viewed as a temporary solution until a long-term solution to the congestion is identified.

Total costs for this action are estimated to be approximately $1.2M, exclusive of potential right-of-way acquisitions, bridge reconstruction, mainline widening, or utility pole relocation.

11 Report 369 - Use of Shoulders and Narrow Lanes to Increase Freeway Capacity; National Cooperative Highway Research Project, Transportation Research Board; Washington DC 1995
Safety Implications of Using Highway Shoulders as Travel Lanes; Alicia Powell Wilson, Central Transportation Planning Staff; Boston, Massachusetts; April 1997.

4.3.5 Other Alternatives Considered

Several other mainline alternatives were considered and subsequently discarded due to limited operational benefits, limited safety improvements, right-of-way impacts, environmental resources impacts, cultural resources impacts, and/or high construction costs. The other alternatives considered include:

- Maintain Baseline Conditions (No-Build/Do-Nothing)
- Construct C-D Roadway along I-95 from RI Exit 30 to MA Exit 2
- Construct C-D Roadway along I-95 from Exit 6 to Exit 7

The benefits and impacts/issues associated with each alternative are presented in the Appendix.

4.4 I-95/I-495 Interchange Alternatives

The interchange improvement alternatives focused on addressing geometric deficiencies, relieving congestion on the ramp systems and local intersections, and improving safety. The potential short- and long-term improvement alternatives for each interchange are described in detail below. Concept plans have been developed for certain alternatives and are included in the Appendix.

4.4.1 I-95: Exit 1/Route 1

Several geometric, safety, and operational issues have been identified at I-95 Exit 1 (Route 1). The issues include:

A. The southbound off-ramp meets design criteria for only 30 mph per MassDOT standards. All ramp roadways should be designed for a minimum of 35 mph.

B. The southbound off-ramp has 500 feet of deceleration length; however, 520 feet are required to meet MassDOT standards.

C. Route 1 is an undivided four-lane roadway through the interchange area.

D. The Scott Street intersection and several driveways are located within 500 feet of the interchange.

E. Vehicles make Route 1 southbound left-turn to I-95 northbound; the interchange is not geometrically designed to accommodate this movement.

F. The intersection of Route 1 at Scott Street crash rate (1.66) exceeds MassDOT average crash rate (0.59).

G. The eastbound and westbound approaches of the intersection of Route 1 at Scott Street currently operate at LOS F/E in the PM and will both operate at LOS F in the PM under future conditions.

The following potential short-term and long-term alternatives were developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-2 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix

Alternative 95-1-A

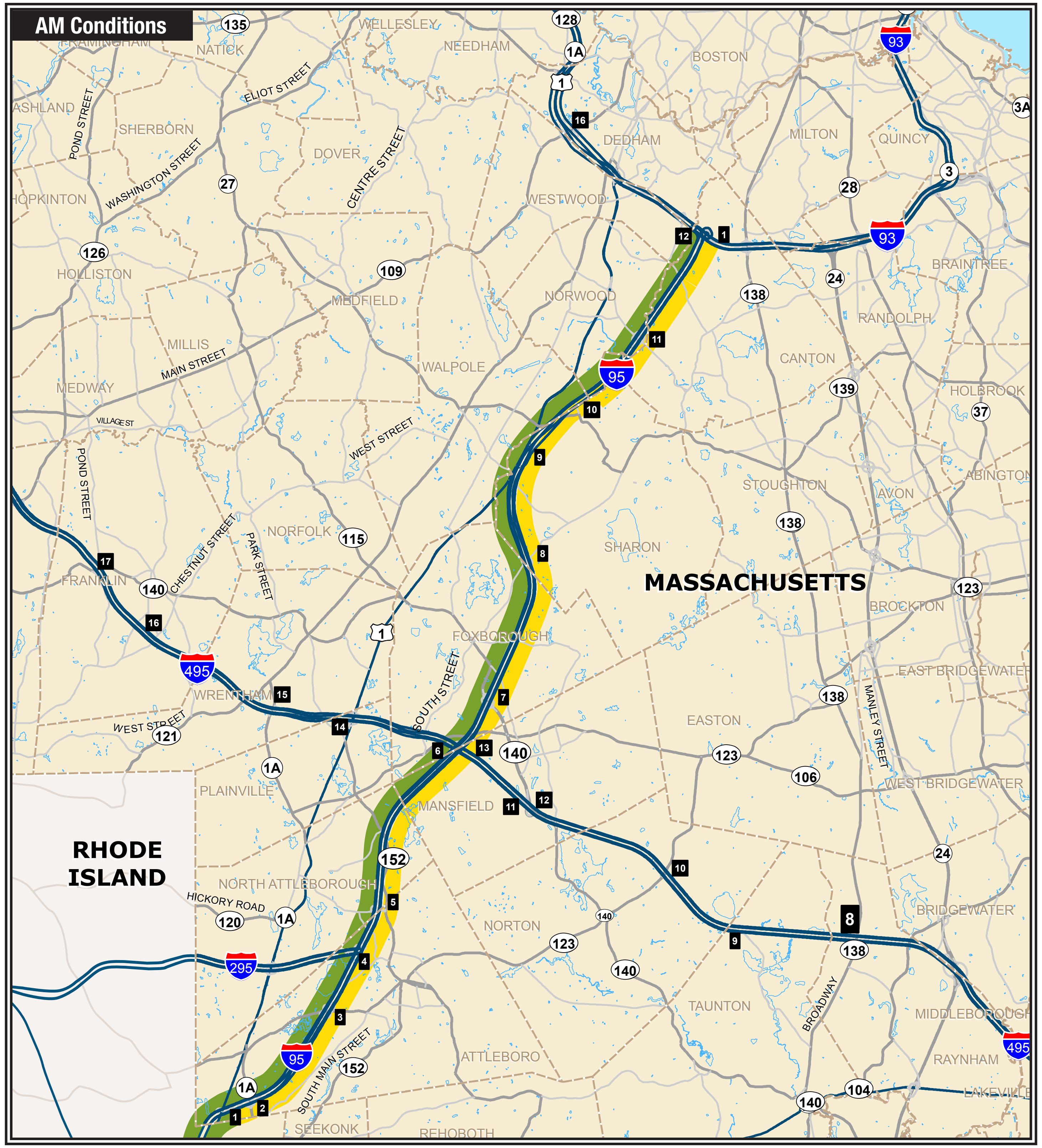
Alternative 95-1-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

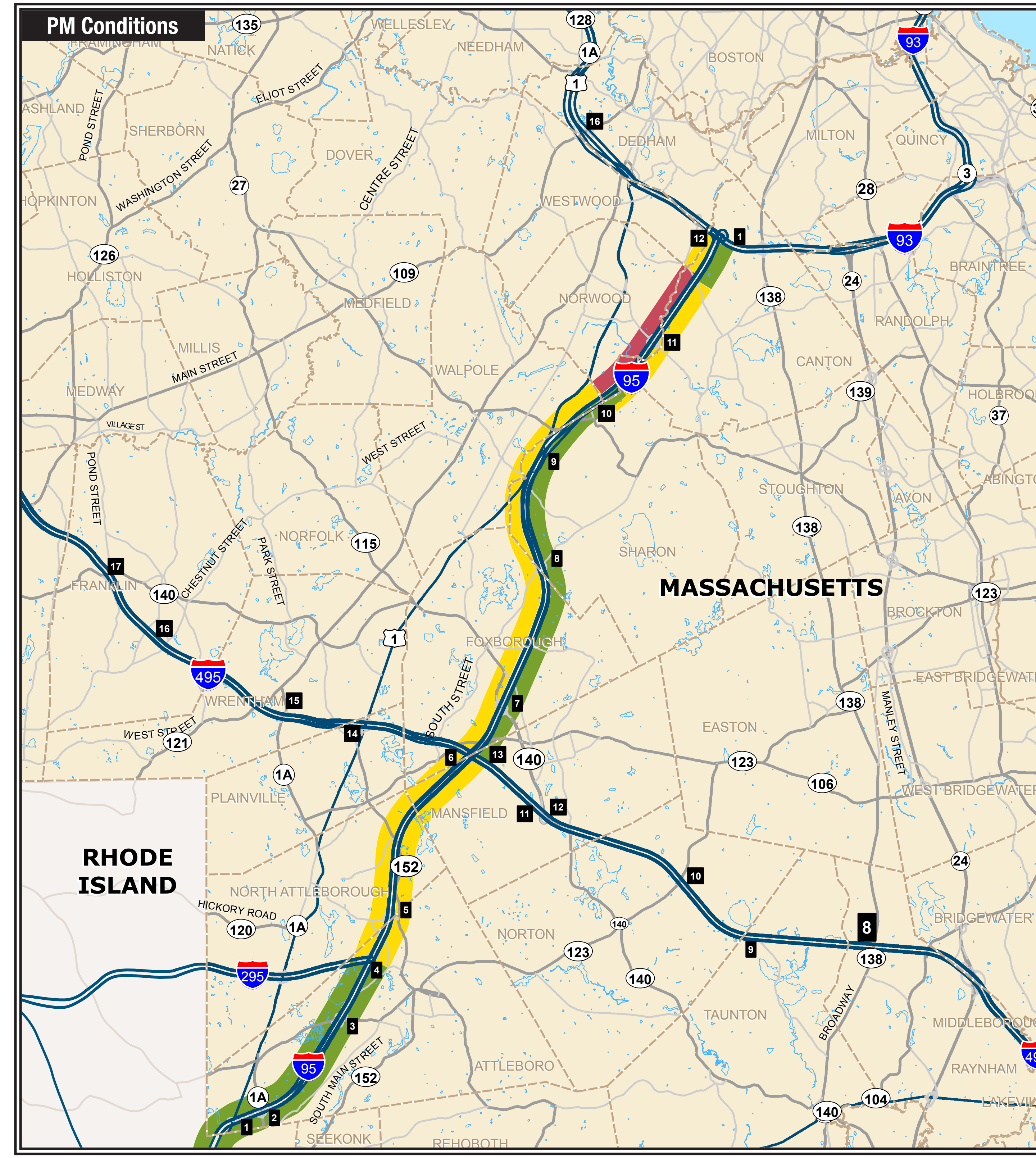
Alternative 95-1-B

Alternative 95-1-B would extend I-95 southbound off-ramp deceleration lane to meet current design standards. To meet current design standards, the I-95 southbound off-ramp deceleration lane would be extended from 500 feet to 520 feet. This alternative would address issue B identified previously. A concept plan has been developed for Alternative 95-1-B and is included in the Appendix.

Alternative 95-1-C

Alternative 95-1-C would restrict Scott Street to right-in/right-out; install a median along Route 1, south of I-95 northbound on-ramp to East Bacon Street. All Scott Street left-turn movements or through traffic on Scott Street would be redirected to occur at the signalized intersection of East Bacon Street at Route 1 where the u-turn movement could be formalized. This alternative would address issues C, F, and G identified previously. A concept plan has been developed for Alternative 95-1-C and is included in the Appendix.





Moving Massachusetts Forward. massDOT

0 50 100 Feet

Source: *Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs*

Legend

Segment Level of Service (LOS)

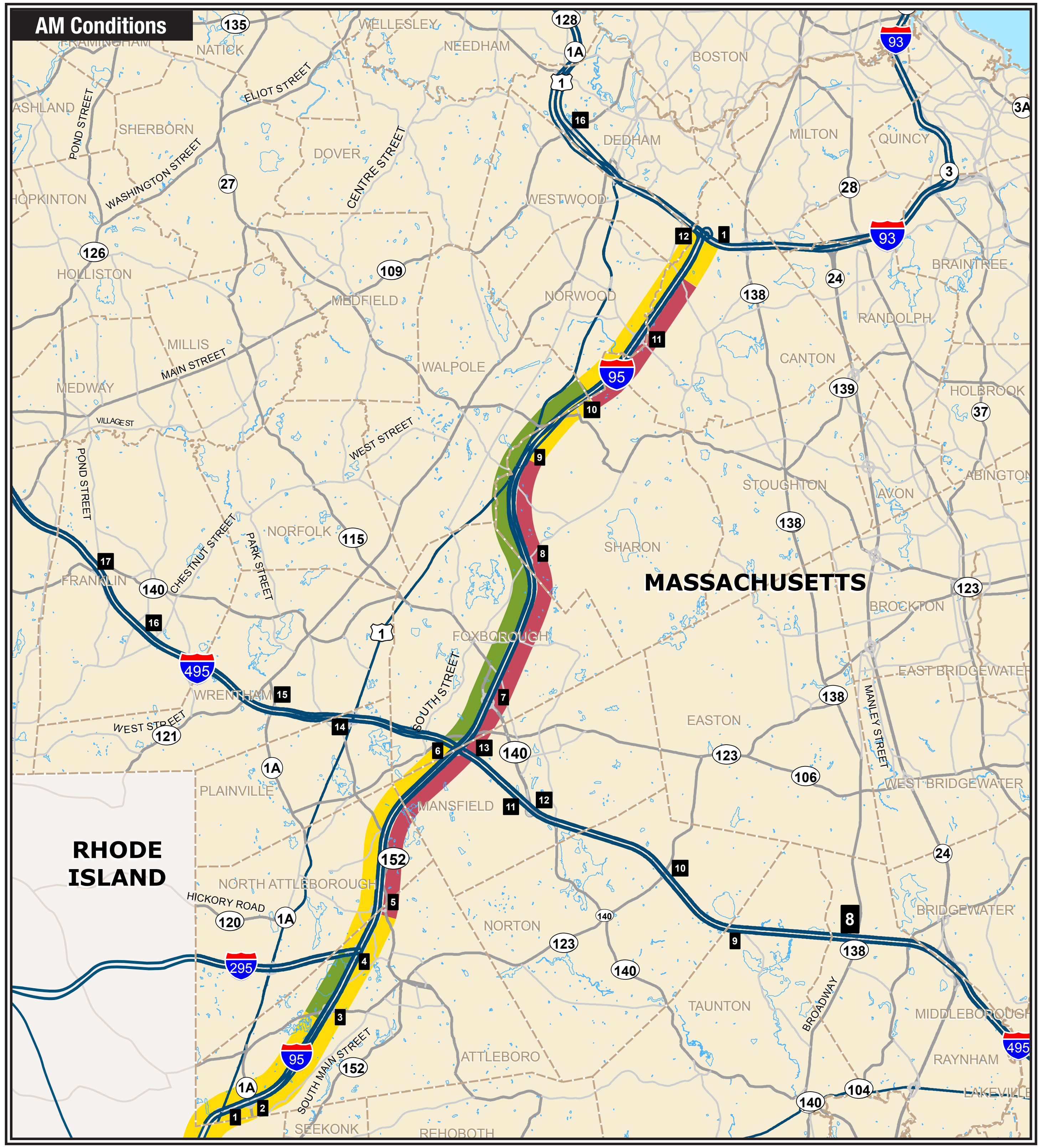
- A / B
- C / D
- E / F

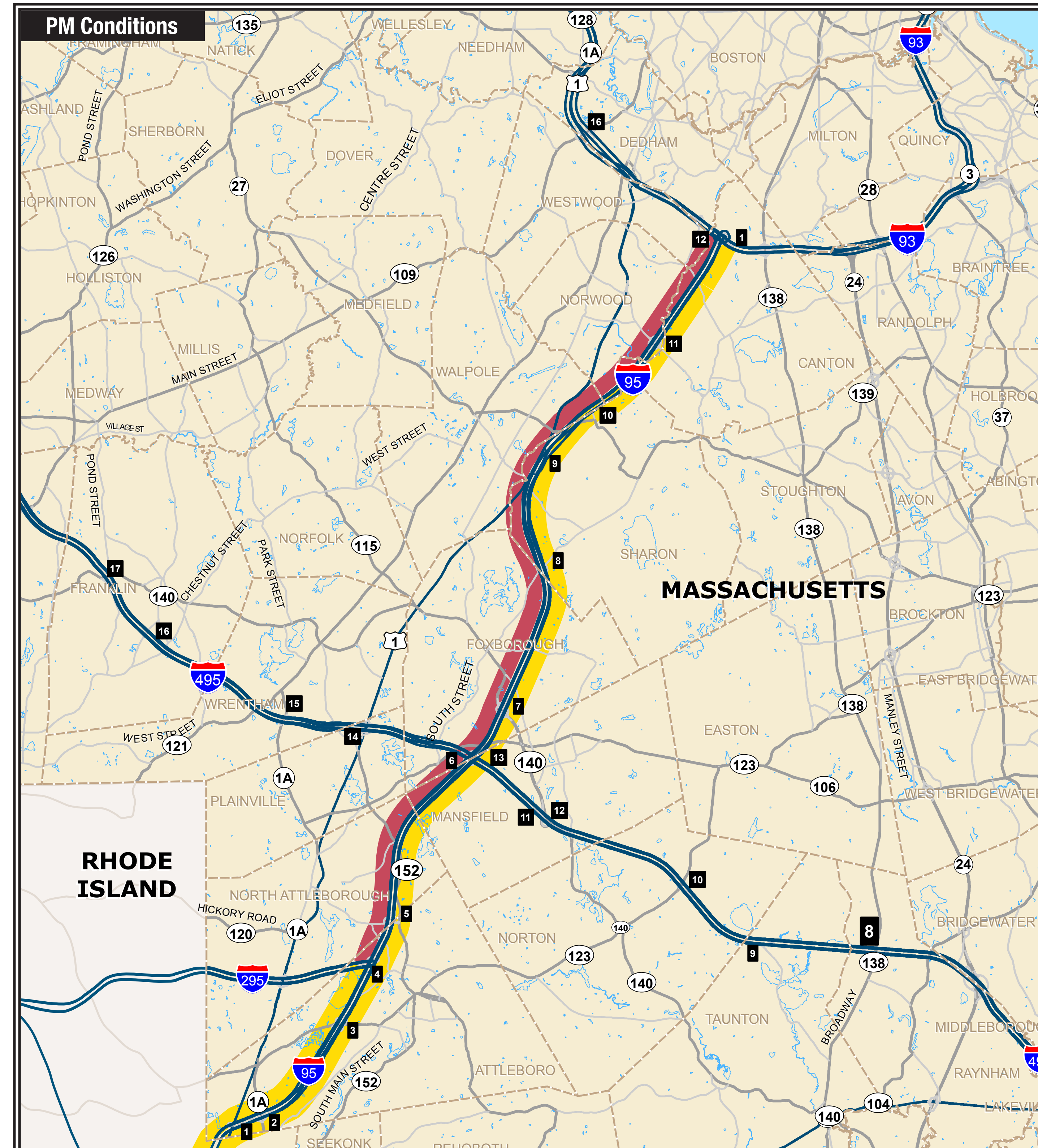
Vanasse Hangen Brustlin, Inc.

Figure 4-1

I-95 Alternative 2
Mainline Widening
Levels of Service (AM / PM)

I-95 South Corridor Study





Moving Massachusetts Forward. massDOT

0 50 100 Feet

Source: *Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs*

Legend

Segment Level of Service (LOS)

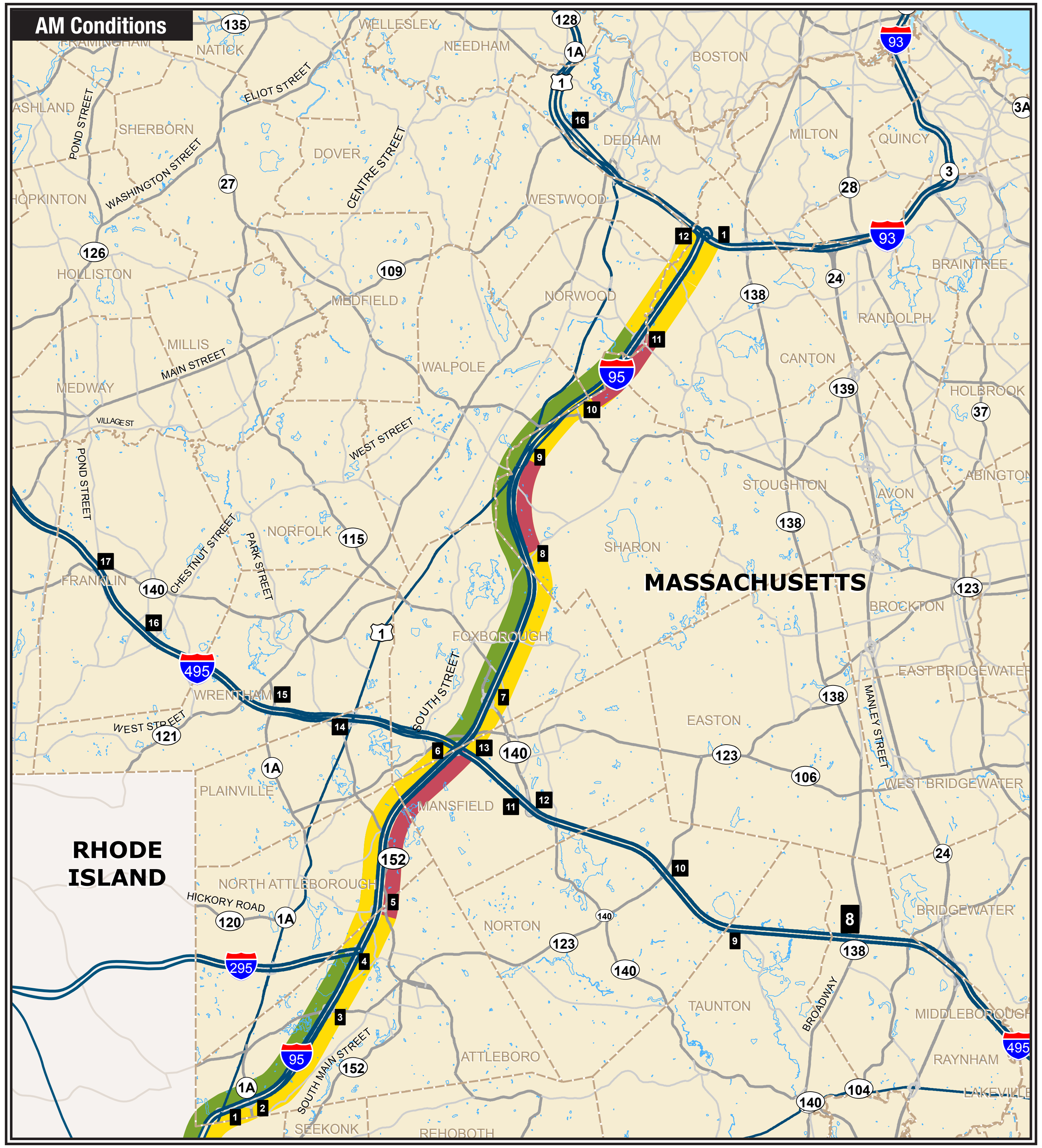
- A / B
- C / D
- E / F

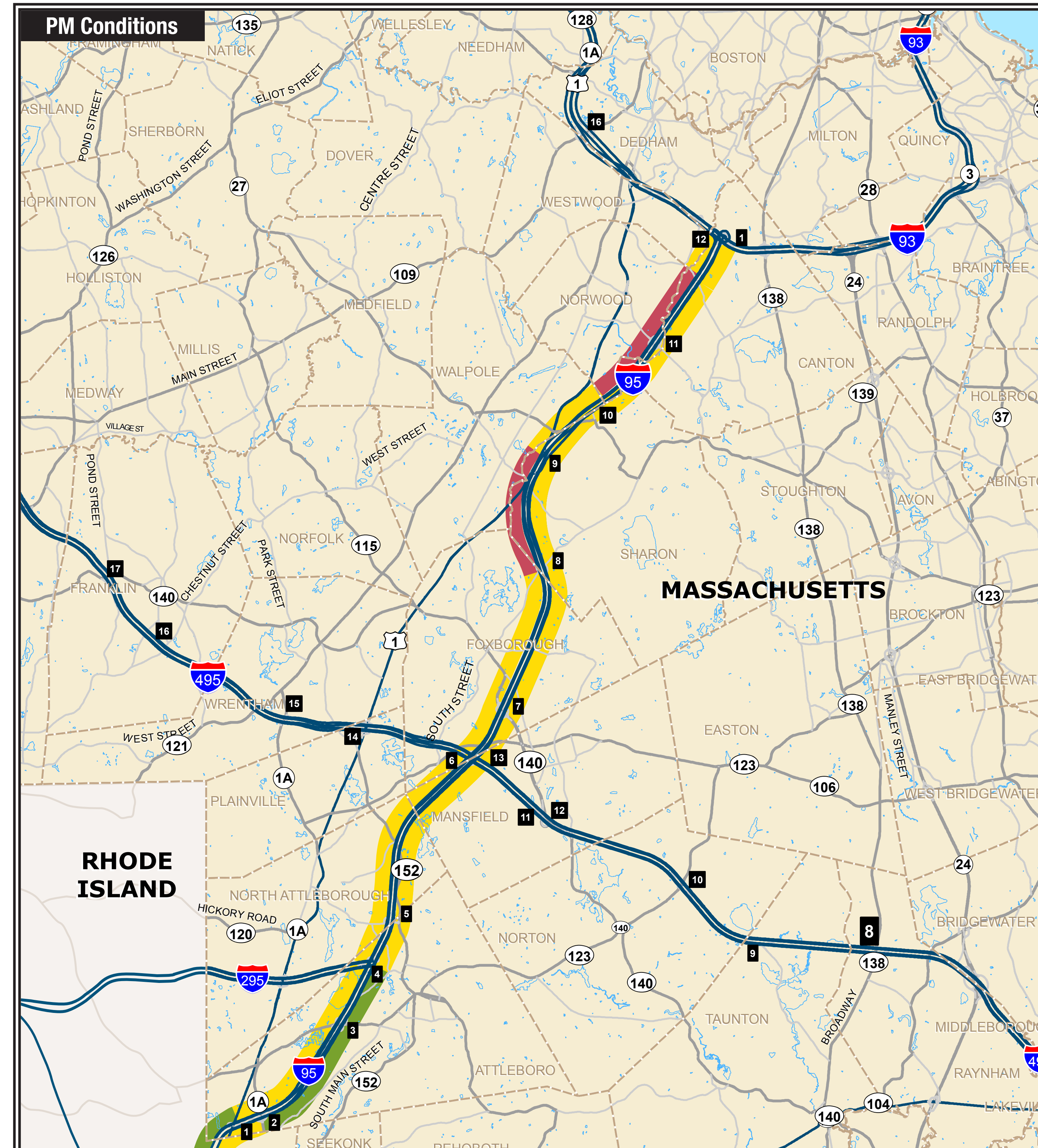
Vanasse Hangen Brustlin, Inc.

Figure 4-2

I-95 Alternative 3
Provision of a High Occupancy Vehicle Lane
Levels of Service (AM / PM)

I-95 South Corridor Study





Moving Massachusetts Forward. massDOT

0 50 100 Feet

Source: *Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs*

Legend

Segment Level of Service (LOS)

- A / B
- C / D
- E / F

Vanasse Hangen Brustlin, Inc.

Figure 4-3

I-95 Alternative 4
Mainline Breakdown Lane Usage
Levels of Service (AM / PM)

I-95 South Corridor Study

Alternative 95-1-D

Alternative 95-1-D would construct a Route 1 southbound left-turn lane at intersection of Route 1 at I-95 northbound on-ramp. Vehicles currently make this left-turn eventhough the interchange is not geometrically designed to accommodate this movement. Under this alternative, three lanes would be carried along Route 1 southbound between the I-95 southbound off-ramp and the I-95 northbound on-ramp and an exclusive left-turn lane would be designated. Modifications to the I-95 northbound on-ramp entrance would be required to formally accommodate left-turns. A median along Route 1 north of the I-95 on-ramp is proposed as part of this alternative. This alternative would address issues C and E identified previously. A concept plan has been developed for Alternative 95-1-D and is included in the Appendix.

Alternative 95-1-E

Alternative 95-1-E considers constructing a Route 1 southbound left-turn lane at intersection of Route 1 at the I-95 northbound on-ramp and installing a traffic signal at the intersection. Vehicles currently make this left-turn even though the interchange is not geometrically designed to accommodate this movement. Under this alternative, three lanes would be carried along Route 1 southbound between the I-95 southbound off-ramp and the I-95 northbound on-ramp and an exclusive left-turn lane would be designated. Modifications to the I-95 northbound on-ramp entrance would be required to formally accommodate left-turns. A median along Route 1 is proposed as part of this alternative. This alternative would address issues C and E identified previously. However, based on the proposed intersection alignment and the fact that this intersection does not meet signal warrants, it was determined that a signal would not be recommended and the alternative was therefore discarded from further consideration.

Alternative 95-1-F

Alternative 95-1-F would construct an I-95 southbound on-ramp at Exit 1 and install a signal at the new intersection. The existing I-95 southbound off-ramp would be reconfigured to minimize land takings as part of this alternative. This alternative would address issues A and B identified previously. A concept plan has been developed for Alternative 95-1-F and is included in the Appendix.

Alternative 95-1-G

Alternative 95-1-G would construct a roundabout to process all movements at the intersections of Route 1 at the existing I-95 northbound on-ramp and at Scott Street. Under this alignment, Route 1 southbound left-turning vehicles to the I-95 northbound on-ramp would be accommodated. Vehicles currently make this left-turn even though the interchange is not geometrically designed to accommodate this movement. This alternative would address issue E identified previously. A concept plan has been developed for Alternative 95-1-G and is included in the Appendix.

Alternative 95-1-H

Alternative 95-1-H would complete the I-95 interchange at Exit 1 by constructing an I-95 northbound off-ramp and I-95 southbound on-ramp. The design of the interchange would create a Single Point Urban Interchange (SPUI). A SPUI is similar to a diamond interchange, but has the advantage of allowing opposing left turns to proceed simultaneously. The design also compresses the two intersections of a traditional diamond interchange into one single intersection over or under the free-flowing roadway. In this case, I-95 would remain free flow and all ramp movements would come to one intersection along Route 1 below I-95. It should be noted that this alternative is problematic from an interchange spacing perspective. This alternative would address issues A and B identified previously.

Alternative 95-1-I

Alternative 95-1-I would complete the I-95 interchange at Exit 1 by constructing an I-95 northbound off-ramp and I-95 southbound on-ramp. The design of the interchange would create a diamond. To accomplish this, the existing I-95 southbound off-ramp loop ramp would be replaced. This alternative would address issues A and B identified previously. A concept plan has been developed for Alternative 95-1-I and is included in the Appendix.

Alternative 95-1-J

Alternative 95-1-J considered removing the interchange. Projected future ramp volumes at this interchange were nominal and could potentially be accommodated at the adjacent interchanges of Exit 30 in Rhode Island and Exit 2 in Massachusetts. This alternative would address issues A, B, C, D, and E identified previously.

C-D Roadway

Construction of a C-D Roadway along I-95 from RI Exit 30 to MA Exit 2 was also considered and is described in more detail in section 4.3.5 and the Appendix

Table 4-2 I-95 Exit 1 (Route 1) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-1-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-1-A detailed notes
95-1-B	Extend I-95 SB off-ramp deceleration lane to meet current design standards	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-1-B detailed notes
95-1-C	Restrict Scott Street to right-in/right-out; install median south of I-95 NB on-ramp to East Bacon St; formalize u-turn at East Bacon St	✓	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-1-C detailed notes
95-1-D	Construct Route 1 SB left-turn lane at intersection of Route 1 at I-95 NB on-ramp	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-1-D detailed notes
95-1-E	Construct Route 1 SB left-turn lane at intersection of Route 1 at I-95 NB on-ramp and signalize (if warranted)	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 95-1-E detailed notes
95-1-F	Construct I-95 SB on-ramp	○	○	○	✖	○	✖	N/A	○	Yes	Refer to Appendix for Alternative 95-1-F detailed notes
95-1-G	Construct roundabout at intersection of Route 1 at I-95 NB on-ramp	○	✓	○	✖	○	✖	N/A	○	Yes	Refer to Appendix for Alternative 95-1-G detailed notes
95-1-H	Construct SPUI interchange	○	○	○	✖	○	✖	N/A	○	No	Refer to Appendix for Alternative 95-1-H detailed notes
95-1-I	Construct tight diamond interchange	○	○	○	✖	○	✖	N/A	○	No	Refer to Appendix for Alternative 95-1-I detailed notes
95-1-J	Remove interchange	○	✓	○	○	○	✖	N/A	○	No	Refer to Appendix for Alternative 95-1-J detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.4.2 I-95: Exit 2/Route 1A

Several geometric, safety, and operational issues have been identified at I-95 Exit 2 (Route 1A). The issues include:

A. All loop ramps meet the design criteria for only 30 mph per MassDOT standards. All ramp roadways should be designed for a minimum of 35 mph.

B. The northbound off-ramp to Route 1A southbound has 275 feet of deceleration length; however, 340 feet is required to meet MassDOT standards.

C. The northbound on-ramp from Route 1A southbound has 785 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

D. The northbound on-ramp from Route 1A northbound has 830 feet of acceleration length; however, 1,230 feet is required to meet MassDOT standards.

E. The southbound on-ramp from Route 1A northbound has 780 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

F. The southbound off-ramp to Route 1A southbound has 465 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

G. The southbound on-ramp from Route 1A southbound has 925 feet of acceleration length; however, 1,230 feet is required to meet MassDOT standards.

H. The MBTA driveway, Bristol Place shopping center entrance, and several driveways are located within 500 feet of the interchange.

I. The intersection of Route 1A at MBTA driveway/Bristol Place crash rate (0.78) exceeds MassDOT average crash rate (0.59).

J. I-95 southbound Exit 2A off-ramp to Route 1A southbound currently operates at LOS E and will degrade to LOS F in PM.

K. Three of the four I-95 off-ramp intersections with Route 1A currently operate at LOS F in PM and will continue to under future conditions.

L. Route 1A at I-95 Northbound Exit 2A off-ramp will degrade to LOS E in the AM in the future.

M. Route 1A at MBTA driveway/Bristol Place westbound approach currently operates at LOS E and will degrade to LOS F in the AM under future conditions.

N. Route 1A at MBTA driveway/Bristol Place eastbound and westbound approaches currently operate at LOS F and continue to operate at LOS F in the PM under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-3 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-2-A

Alternative 95-2-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-2-B

To meet current design standards, the following ramp acceleration/ deceleration lanes would be extended at Exit 2 under Alternative 95-2-B:

- I-95 northbound off-ramp to Route 1A southbound would be extended from 275 feet to 340 feet
- I-95 southbound on-ramp from Route 1A southbound would be extended from 925 feet to 1,230 feet
- I-95 northbound on-ramp from Route 1A northbound would be extended from 830 feet to 1,230 feet

It should be noted that the I-95 northbound on-ramp from Route 1A southbound, the I-95 southbound on-ramp from Route 1A northbound, and the I-95 southbound off-ramp to Route 1A southbound are also deficient. However, the downstream off-ramp or upstream on-ramp prohibits lengthening of the acceleration or deceleration lanes for these loop ramps. This alternative would therefore address issues B, D, and G identified previously. A concept plan has been developed for Alternative 95-2-B and is included in the Appendix.

Alternative 95-2-C

Alternative 95-2-C would construct a full-access signal at the intersection of Route 1A at Bristol Place Shopping Center/MBTA driveway; this signal would accommodate left-turns to and from the minor street approaches. Peak hour signal warrants are met for this location, but additional information is needed to verify if the Four-Hour Warrant is met before signal installation is recommended. This alternative would address issues I and M identified previously.

Table 4-3 I-95 Exit 2 (Route 1A) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-2-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 95-2-A detailed notes
95-2-B	Extend acceleration/deceleration lanes to meet current design standards (6 ramps)	O	✓	O	O	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-2-B detailed notes
95-2-C	Provide full-access signal at intersection of Route 1A at Bristol Place Shopping Center/MBTA driveway (if warranted)	✖	O	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 95-2-C detailed notes
95-2-D	Construct partial cloverleaf interchange; eliminate loop ramps accommodating off-ramp movements; signalize intersections (if warranted)	✓	O	✓	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-2-D detailed notes
95-2-E	Construct partial cloverleaf interchange; eliminate loop ramps accommodating on-ramp movements; signalize intersections (if warranted)	✓	O	✓	O	✓	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-2-E detailed notes
95-2-F	Construct diamond interchange; eliminate cloverleaf ramps; signalize intersections (if warranted)	✓	O	✓	O	✖	O	N/A	✓	No	Refer to Appendix for Alternative 95-2-F detailed notes
95-2-G	Consolidate gas station driveways along Route 1A SB between I-95 NB off-ramp and MBTA driveway	✓	✓	O	✖	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-2-G detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 95-2-D

Alternative 95-2-D would construct a partial cloverleaf interchange. The existing cloverleaf ramps in the southeast and northwest quadrants accommodating I-95 northbound and southbound off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. Alternative 95-2-D would result in LOS D or better for all merge and diverge movements along I-95 as well as all movements at the new intersection. This alternative would enhance bicycle and pedestrian accommodations by eliminating weaving maneuvers and installing a signal with accommodations for these users. This alternative would address issues A, F, J, K, and L identified previously. A concept plan has been developed for Alternative 95-2-D and is included in the Appendix.

Alternative 95-2-E

Alternative 95-2-E would construct a partial cloverleaf interchange. The existing cloverleaf ramps in the southwest and northeast quadrants accommodating I-95 northbound and southbound on-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. Alternative 95-2-E would result in LOS D or better for all merge and diverge movements along I-95 as well as all movements at the new intersections. This alternative would enhance bicycle and pedestrian accommodations by eliminating weaving maneuvers and installing a signal with accommodations for these users. This alternative would address issues A, C, E, and K identified previously. A concept plan has been developed for Alternative 95-2-E and is included in the Appendix.

Alternative 95-2-F

Alternative 95-2-F would construct a diamond interchange in all quadrants. All existing ramps accommodating I-95 northbound and southbound on- and off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. Alternative 95-2-F would result in LOS D or better for all merge and diverge movements along I-95 as well as all movements at the new intersection. This alternative would enhance bicycle and pedestrian accommodations by eliminating weaving maneuvers and installing a signal with accommodations for these users. This alternative would address issues A, B, C, D, E, F, G, H, J, K and L identified previously. A concept plan has been developed for Alternative 95-2-F and is included in the Appendix.

Alternative 95-2-G

Alternative 95-2-G would consolidate the gas station driveways along Route 1A southbound between the I-95 northbound off-ramp and MBTA driveway. Coordination with private land owners would be necessary to implement this alternative. This alternative would partially address issue H identified previously.

4.4.3 I-95: Exit 3/Route 123

Several geometric, safety, and operational issues have been identified at I-95 Exit 3 (Route 123). The issues include:

A. The northbound on-ramp from Route 123 eastbound meets the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. The northbound on-ramp from Route 123 westbound, the southbound on-ramp, and the southbound off-ramp to Route 123 eastbound meet the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

C. The northbound on-ramp from Route 123 eastbound has 815 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

D. The northbound on-ramp from Route 123 westbound has 1,165 feet of acceleration length; however, 1,420 feet is required to meet MassDOT standards.

E. The southbound on-ramp has 835 feet of acceleration length; however, 1,420 feet is required to meet MassDOT standards.

F. Greenfield Street, Lathrop Road, and several driveways are within 500 feet of the interchange.

G. The intersection of Route 123 at Lathrop Road crash rate (0.79) exceeds MassDOT average crash rate (0.59).

H. The southbound off-ramp to Route 123 eastbound operates at LOS F under existing and future conditions in the PM.

I. The Route 123 at I-95 northbound off-ramp northbound approach will degrade to LOS E in the AM future conditions.

J. The Route 123 at I-95 northbound off-ramp northbound approach operates at LOS F under existing and future conditions in the PM.

K. Route 123 at Lathrop Road southbound approach operates at LOS F under existing and future conditions in the AM and PM.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-4 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-3-A

Alternative 95-3-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-3-B

To meet current design standards, the following ramp acceleration lanes would be extended at Exit 3:

- I-95 northbound on-ramp from Route 123 eastbound would be extended from 815 feet to 1,350 feet
- I-95 northbound on-ramp from Route 123 westbound would be extended from 1,165 feet to 1,420 feet

It should be noted that the I-95 southbound on-ramp acceleration lane is also deficient (835 feet are currently provided, 1,420 feet are required). However, the downstream off-ramp deceleration lane for Exit 2A prohibits lengthening of the acceleration lane. This alternative would therefore address issues C and D identified previously. A concept plan has been developed for Alternative 95-3-B and is included in the Appendix.

Alternative 95-3-C

Alternative 95-3-C would restrict Lathrop Road to right-in/right-out access only. The median dividing Route 123 would be extended through the Lathrop Road intersection. This alternative would address issues G and K identified previously.

Alternative 95-3-D

Alternative 95-3-D would prohibit Lathrop Road southbound left-turns. Also, Route 123 eastbound would be widened to accommodate a left-turn lane with 125 feet of storage to Lathrop Road. This improvement would require vehicles travelling southbound on Lathrop Road to utilize Thacher Street for access to the east. This alternative would address issues G and K identified previously.

Alternative 95-3-E

Alternative 95-3-E would install a fully actuated traffic signal at the intersection of Route 123 at Lathrop Road. Peak hour signal warrants are met for this location. No geometric improvements are proposed as part of this alternative. This alternative would address issues G and K identified previously.

Alternative 95-3-F

Alternative 95-3-F would close Lathrop Road from Route 123 to Thacher Street. Access to Route 123 would be provided at the intersection of Thacher Street/Snell Street to the east. This alternative would address issues G and K identified previously.

Alternative 95-3-G

Alternative 95-3-G includes installing a fully actuated traffic signal at the intersection of Route 123 at the I-95 northbound off-ramp (location meets peak hour signal warrants). No geometric improvements are proposed at this location. Vehicles currently make a northbound left-turn in two stages: crossing Route 123 eastbound traffic and waiting in the median, then merging with Route 123 westbound traffic. Providing a signal at this location would improve safety and visibility for I-95 northbound off-ramp left-turning vehicles. This alternative would address issues I and J identified previously.

Alternative 95-3-H

Alternative 95-3-H includes removing the I-95 southbound off-ramp to Route 123 eastbound and accommodating the movement at the other I-95 southbound off-ramp. The intersection would be signalized. Peak hour signal warrants are met for this location. This alternative would address issues B and H identified previously. A concept plan has been developed for Alternative 95-3-H and is included in the Appendix.

Alternative 95-3-I

Alternative 95-3-I includes removing the I-95 southbound off-ramp to Route 123 eastbound and accommodating the movement at the other I-95 southbound off-ramp. An I-95 southbound on-ramp from Route 123 eastbound would also be constructed and the intersection would be signalized. Peak hour signal warrants are met for this location. This alternative would therefore address issues B and H identified previously. A concept plan has been developed for Alternative 95-3-I and is included in the Appendix.

Table 4-4 I-95 Exit 3 (Route 123) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?: Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-3-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 95-3-A detailed notes
95-3-B	Extend acceleration lanes to meet current design standards (3 ramps)	O	✓	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-B detailed notes
95-3-C	Restrict Lathrop Road to right-in/right-out	✓	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-C detailed notes
95-3-D	Prohibit Lathrop Road SB left-turns; widen Route 123 EB to accommodate left-turn lane to Lathrop Road	✓	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-D detailed notes
95-3-E	Signalize intersection of Route 123 at Lathrop Road (if warranted)	✖	✓	O	✖	O	O	N/A	✖	Yes	Refer to Appendix for Alternative 95-3-E detailed notes
95-3-F	Close Lathrop Road from Route 123 to Thacher Street	O	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-F detailed notes
95-3-G	Signalize intersection of Route 123 at I-95 NB ramps (if warranted)	✓	✓	O	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-G detailed notes
95-3-H	Remove I-95 SB off-ramp to Route 123 EB; accommodate movement at other I-95 SB off-ramp; signalize intersection (if warranted)	✓	✓	O	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-H detailed notes
95-3-I	Remove I-95 SB off-ramp to Route 123 EB; construct I-95 SB on-ramp from Route 123 EB; signalize intersection (if warranted)	✓	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-I detailed notes
95-3-J	Remove I-95 NB on-ramp from Route 123 WB; accommodate movement at other I-95 NB on-ramp; signalize intersection (if warranted)	O	✓	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 95-3-J detailed notes
95-3-K	Realign Lathrop Road with I-95 ramps; remove I-95 NB on-ramp from Route 123 EB; signalize intersection	✓	✓	O	✓	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-3-K detailed notes
95-3-L	Construct diamond interchange; eliminate cloverleaf ramps; signalize intersections	✓	✓	O	✖	✖	O	N/A	✓	No	Refer to Appendix for Alternative 95-3-L detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 95-3-J

Alternative 95-3-J includes removing the existing I-95 northbound on-ramp from Route 123 westbound and accommodating the movement at the other I-95 northbound on-ramp. The intersection would be signalized. Peak hour signal warrants are met for this location. This alternative would therefore address issues B, D, I and J identified previously. A concept plan has been developed for Alternative 95-3-J and is included in the Appendix.

Alternative 95-3-K

Alternative 95-3-K includes realigning Lathrop Road with the I-95 northbound ramps; installing a cul-de-sac at the existing Lathrop Road; removing the existing I-95 northbound on-ramp from Route 123 westbound; and installing a fully actuated traffic signal. Peak hour signal warrants are met for this location. This alternative would address issues B, D, F, G, I, J and K identified previously. A concept plan has been developed for Alternative 95-3-K and is included in the Appendix.

Alternative 95-3-L

Alternative 95-3-L would construct a diamond interchange in all quadrants. All existing ramps accommodating I-95 northbound and southbound on- and off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A, B, C, D, E, F, H, I, and J identified previously. A concept plan has been developed for Alternative 95-3-L and is included in the Appendix.

4.4.4 I-95: Exit 4/I-295

Several geometric, safety, and operational issues have been identified at I-95 Exit 4 (I-295). The issues include:

A. All ramps meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 50 mph per MassDOT design standards.
B. The northbound on-ramp from I-295 northbound has 955 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.
C. The southbound off-ramp to I-295 southbound has 295 feet of deceleration length; however, 340 feet is required to meet MassDOT standards.
D. The southbound on-ramp from I-295 northbound has 905 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.
E. I-95 northbound Exit 4 on-ramp from I-295 operates at LOS E/F in the AM/PM currently and will degrade to LOS F in both AM and PM.
F. I-95 northbound Exit 4 off-ramp to I-295 operates at LOS F under existing and future conditions in the AM and PM.
G. I-95 southbound Exit 4 off-ramp to I-295 operates at LOS F under existing and future conditions in the PM.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-5 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-4-A

Alternative 95-4-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-4-B

To meet current design standards, the following ramp acceleration/deceleration lanes would be extended at Exit 4:

- I-95 southbound off-ramp to I-295 southbound would be extended from 295 feet to 340 feet
- I-95 southbound on-ramp from I-295 northbound would be extended from 905 feet to 1,350 feet

It should be noted that the I-95 northbound on-ramp acceleration lane is also deficient (955 feet are currently provided, 1,350 feet are required). However, the downstream off-ramp deceleration lane prohibits lengthening of the acceleration lane. This alternative would therefore address issues C and D identified previously. A concept plan has been developed for Alternative 95-4-B and is included in the Appendix.

Alternative 95-4-C

Alternative 95-4-C would replace the existing I-95 southbound to I-295 southbound ramp with a two-lane, high-speed ramp (70 mph). The deceleration lane would also be extended. This alternative would address issues A, C, and G identified previously. A concept plan has been developed for Alternative 95-4-C and is included in the Appendix.

Table 4-5 I-95 Exit 4 (I-295) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-4-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 95-4-A detailed notes
95-4-B	Extend acceleration/deceleration lanes to meet current design standards (3 ramps)	O	✓	O	✖	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-B detailed notes
95-4-C	I-95 SB to I-295 SB: Construct new high-speed ramp connection (2 lanes); eliminate existing ramp	✓	✓	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-C detailed notes
95-4-D	I-295 NB to I-95 SB: Realign ramp to flatten curve	O	✓	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-D detailed notes
95-4-E	I-95 NB to I-295 SB: Increase ramp radius	O	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-E detailed notes
95-4-F	I-295 NB to I-95 NB: Construct new ramp; remove existing loop ramp	O	✓	O	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-F detailed notes
95-4-G	Construct C-D road	✓	✓	O	✖	O	O	N/A	O	Yes	Refer to Appendix for Alternative 95-4-G detailed notes
95-4-H	I-295 NB to I-95 NB: Construct flyover ramp; remove existing loop ramp	✓	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 95-4-H detailed notes
95-4-I	Construct compressed trumpet interchange	O	O	O	✖	O	O	N/A	O	No	Refer to Appendix for Alternative 95-4-I detailed notes
95-4-J	Construct 3-level ramp system	✓	✓	O	✖	O	✖	N/A	✓	No	Refer to Appendix for Alternative 95-4-J detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 95-4-D

Alternative 95-4-D would realign the I-295 northbound to I-95 southbound ramp to eliminate the existing broken-back curve. The acceleration lane would also be extended. This alternative would address issues A and D identified previously. A concept plan has been developed for Alternative 95-4-D and is included in the Appendix.

Alternative 95-4-E

Alternative 95-4-E would replace the existing I-95 northbound to I-295 southbound loop ramp with a redesigned ramp that meets current design standards. This alternative would address issue A identified previously. A concept plan has been developed for Alternative 95-4-E and is included in the Appendix.

Alternative 95-4-F

Alternative 95-4-F would replace the existing I-295 northbound to I-95 northbound loop ramp with a redesigned two-lane ramp that meets current design standards. The acceleration lane would also be lengthened to meet current design standards. To accomplish this, the auxiliary lane would be extended to the next interchange. This alternative would address issues A, B, and E identified previously. A concept plan has been developed for Alternative 95-4-F and is included in the Appendix.

Alternative 95-4-G

Alternative 95-4-G would construct a two lane collector-distributor road into the median along I-95 northbound. The collector-distributor road would accommodate the I-95 northbound on- and off-ramp maneuvers. Vehicles travelling through along I-95 northbound would not interact with Exit 4 ramp maneuvers, except at the collector-distributor road diverge and merge points. This alternative would address issues B, E, and F identified previously. A concept plan has been developed for Alternative 95-4-G and is included in the Appendix.

Alternative 95-4-H

Alternative 95-4-H would replace the existing I-295 northbound to I-95 northbound loop ramp with a high-speed (70 mph) directional, two-lane ramp. The acceleration lane would also be lengthened to meet current design standards. To accomplish this, the auxiliary lane would be extended to the next interchange. The removal of the I-295 northbound to I-95 northbound loop ramp would also make it possible to extend the I-95 northbound to I-295 southbound loop ramp deceleration lane. This alternative would address issues A, B, and E identified previously. A concept plan has been developed for Alternative 95-4-H and is included in the Appendix.

Alternative 95-4-I

Alternative 95-4-I would replace the existing I-95 northbound and southbound off-ramps to I-295 with a compressed trumpet interchange. The existing off-ramps would be eliminated. The bridge carrying the I-95 northbound to I-295 southbound movement would be removed. A new bridge would be constructed to carry the I-95 northbound to I-295 southbound compressed trumpet loop ramp. This alternative would address issues A, C, F and G identified previously. A concept plan has been developed for Alternative 95-4-I and is included in the Appendix.

Alternative 95-4-J

Alternative 95-4-J would construct a three-level ramp system. Under this alternative, the I-295 northbound to I-95 northbound and I-95 northbound to I-295 southbound loop ramps would be replaced with a three-tiered, high-speed directional, two-lane ramp system. The proposed I-95 southbound ramp geometry would remain in place. This alternative would address issues A, B, E and F identified previously. A concept plan has been developed for Alternative 95-4-J and is included in the Appendix.

4.4.5 I-95: Exit 5/Toner Boulevard/Route 152

Several geometric, safety, and operational issues have been identified at I-95 Exit 5 (Toner Boulevard/Route 152). The issues include:

A. The northbound off-ramp meets the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.
B. The southbound on-ramp meets the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.
C. The northbound off-ramp has 455 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.
D. The northbound on-ramp has 850 feet of acceleration length; however, 1,230 feet is required to meet MassDOT standards.
E. The southbound on-ramp has 795 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.
F. Robert F. Toner Boulevard is a four-lane undivided roadway through the interchange area.
G. The John L. Dietsch Boulevard and Route 152 intersections are within 500 feet of the interchange.
H. The intersection of Toner Boulevard at Route 152 crash rate (1.07) exceeds MassDOT average crash rate (0.84).
I. I-95 northbound Exit 5 on-ramp operates at LOS E the AM currently and will degrade to LOS F.
J. I-95 southbound Exit 5 on-ramp will degrade to LOS E in the PM under future conditions.

K. I-95 northbound Exit 5 off-ramp operates at LOS E the AM under existing and future conditions.
L. I-95 southbound Exit 5 off-ramp operates at LOS E the PM under existing and future conditions.
M. Toner Boulevard at I-95 northbound ramps southbound approach currently operates at LOS F in the AM and PM; planned signal installation will improve operations.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-6 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-5-A

Alternative 95-5-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-5-B

Alternative 95-5-B would improve signage along I-95 southbound for advanced warning of Exit 5 and Exit 4 and would provide improved safety along I-95 mainline. Currently, signage for Exit 4 (I-295) is shown before signage for I-95 Exit 5 (Toner Blvd/Route 152), causing confusion among motorists.

Alternative 95-5-C

To meet current design standards, the following three ramp acceleration/ deceleration lanes would be extended at Exit 5:

- I-95 northbound off-ramp would be extended from 455 feet to 520 feet
- I-95 northbound on-ramp would be extended from 850 feet to 1,230 feet
- I-95 southbound on-ramp would be extended from 795 feet to 1,350 feet

This alternative would address issues C, D, and E identified previously. A concept plan has been developed for Alternative 95-5-C and is included in the Appendix.

Alternative 95-5-D

Alternative 95-5-D would install advanced signage for signal at end of I-95 northbound off-ramp. This action could improve driver anticipation of a signal ahead.

Alternative 95-5-E

Alternative 95-5-E considered constructing a Park and Ride lot in the former Triboro Plaza movie theater parking lot located along Dietsch Boulevard. Constructing a Park and Ride lot at this location would require coordination with private land owners. A Park and Ride lot in this location could provide direct access for commuters to I-95 and to GATRA bus services.

Alternative 95-5-F

Alternative 95-5-F considered constructing a Park and Ride lot in the southwest quadrant of the interchange along Toner Boulevard. This location could provide direct access to Toner Boulevard opposite John Dietsch Boulevard. A Park and Ride lot in this location could provide direct access for commuters to I-95 and to GATRA bus services.

4.4.6 I-95: Exit 6/I-495: Exit 13

Several geometric, safety, and operational issues have been identified at I-95 Exit 6 (I-495). The issues include:

A. The I-495 southbound to I-95 northbound loop ramp meets the design criteria for only 25 mph. The I-95 northbound to I-495 northbound loop ramp, I-495 northbound to I-95 northbound ramp, I-495 northbound to I-95 southbound loop ramp, and I-95 southbound to I-495 southbound loop ramp meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 50 mph for system interchanges per MassDOT design standards.

B. The I-95 northbound off-ramp to I-495 southbound has 250 feet of deceleration length; however, 390 feet is required to meet MassDOT standards.

C. The I-95 northbound on-ramp from I-495 southbound has 900 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

D. The I-95 northbound on-ramp from I-495 northbound has 840 feet of acceleration length; however, 1,230 feet is required to meet MassDOT standards.

E. I-95 southbound off-ramp to I-495 northbound has 370 feet of deceleration length; however, 440 feet is required to meet MassDOT standards.

F. The I-95 southbound on-ramp from I-495 northbound has 950 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

G. The I-95 southbound on-ramp from I-495 southbound has 775 feet of acceleration length; however, 1,230 feet is required to meet MassDOT standards.

H. The I-495 northbound off-ramp to I-95 northbound has 450 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

I. The I-495 northbound on-ramp from I-95 northbound has 1,060 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

J. The I-495 northbound on-ramp from I-95 southbound has 930 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

K. The I-495 southbound off-ramp to I-95 southbound has 490 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

Table 4-6 I-95 Exit 5/Toner Boulevard/Route 152 Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?								Can Alternative can be combined with other Alternatives?	Notes
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs		
95-5-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-5-A detailed notes
95-5-B	Address signage issues along I-95 SB (Exit 5 vs. Exit 4)	○	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-5-B detailed notes
95-5-C	Extend acceleration/deceleration lanes to meet current design standards (3 ramps)	○	✓	○	○	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-5-C detailed notes
95-5-D	Install advanced signage for signal at end of I-95 NB off-ramp	○	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-5-D detailed notes
95-5-E	Construct Park and Ride Lot in movie theater parking lot on Dietsch Boulevard	○	○	✓	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-5-E detailed notes
95-5-F	Construct Park and Ride Lot in SW quadrant of interchange along Toner Boulevard	○	○	✓	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-5-F detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

L. The I-495 southbound on-ramp from I-95 southbound has 975 feet of acceleration length is; however, 1,350 feet is required to meet MassDOT standards.

M. The I-495 southbound on-ramp from I-95 northbound has 830 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

N. I-95 northbound Exit 6A and 6B on-ramps operate at LOS E/F the AM currently and will degrade to LOS F in the future conditions.

O. I-95 southbound Exit 6A and 6B on-ramps operate at LOS E/F the PM currently and will degrade to LOS F in the future conditions.

P. I-95 northbound Exit 6A and 6B off-ramps operate at LOS E/F the AM currently and will degrade to LOS F in the future conditions.

Q. I-95 northbound Exit 6B off-ramps will degrade to LOS F in the PM under future conditions.

R. I-95 southbound Exit 6A and 6B off-ramps operate at LOS F/E in the PM under existing and future conditions.

S. I-495 northbound Exit 13a on-ramp and 13b off-ramps will degrade to LOS F in the AM and PM future conditions.

T. I-495 southbound Exit 13b on-ramp and 13a off-ramps will degrade to LOS F in the AM and PM future conditions.

U. The weaving segment along I-95 northbound at Exit 6 operates at LOS E and will degrade to LOS F in the AM future conditions.

V. The weaving segment along I-95 southbound at Exit 6 operates at LOS E and will degrade to LOS F in the PM future conditions.

W. The weaving segment along I-495 northbound at Exit 13 will degrade to LOS E in the AM and PM future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-7 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimate for each alternative is presented in the Appendix.

Alternative 95-6-A

Alternative 95-6-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-6-B

To meet current design standards, the following ramp acceleration/ deceleration lanes would be extended at Exit 6:

- I-95 southbound off-ramp to I-495 northbound would be extended from 370 feet to 440 feet
- I-495 southbound off-ramp to I-95 southbound would be extended from 490 feet to 520 feet
- I-95 northbound off-ramp to I-495 southbound would be extended from 250 feet to 390 feet
- I-495 southbound on-ramp from I-95 northbound would be extended from 830 feet to 1,350 feet
- I-95 northbound on-ramp from I-495 northbound would be extended from 840 feet to 1,230 feet
- I-495 northbound off-ramp to I-95 northbound would be extended from 450 feet to 520 feet
- I-495 northbound on-ramp from I-95 southbound would be extended from 930 feet to 1,350 feet
- I-95 southbound on-ramp from I-495 southbound would be extended from 775 feet to 1,230 feet

Also, the following loop ramps are deficient:

- I-95 northbound on-ramp from I-495 southbound
- I-95 southbound on-ramp from I-495 northbound
- I-495 northbound on-ramp from I-95 northbound
- I-495 southbound on-ramp from I-95 southbound

However, the downstream off-ramp or upstream on-ramp prohibits lengthening of the acceleration or deceleration lanes. This alternative would address issues B, D, E, G, H, J, K and M identified previously. A concept plan has been developed for Alternative 95-6-B and is included in the Appendix.

Alternative 95-6-C

Alternative 95-6-C would realign the following ramps to flatten curves:

- I-95 northbound to I-495 southbound
- I-495 northbound to I-95 northbound
- I-95 southbound to I-495 northbound
- I-495 southbound to I-95 southbound

Table 4-7 I-95 Exit 6 (I-495) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-6-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-6-A detailed notes
95-6-B	Extend acceleration/deceleration lanes to meet current design standards (12 ramps)	○	✓	○	✖	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-B detailed notes
95-6-C	Realign outer ramps to flatten curves; provide 2 lane ramps	✓	✓	○	✖	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-C detailed notes
95-6-D	Construct C-D road in median of I-95 NB and SB	✓	✓	○	✖	○	○	N/A	○	Yes	Refer to Appendix for Alternative 95-6-D detailed notes
95-6-E	Eliminate West Street over I-495 (to be combined with H or I only)	✖	○	○	✖	○	○	N/A	○	Yes	Refer to Appendix for Alternative 95-6-E detailed notes
95-6-F	I-95 NB to I-495 NB: Construct flyover ramp; remove existing loop ramp	✓	✓	○	✖	✖	✖	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-F detailed notes
95-6-G	I-495 SB to I-95 NB: Construct flyover ramp; remove existing loop ramp	✓	✓	○	✖	✖	✖	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-G detailed notes
95-6-H	I-95 SB to I-495 SB: Construct flyover ramp; remove existing loop ramp	✓	✓	○	✖	✖	✖	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-H detailed notes
95-6-I	I-495 NB to I-95 SB: Construct flyover ramp; remove existing loop ramp	✓	✓	○	✖	✖	✖	N/A	✓	Yes	Refer to Appendix for Alternative 95-6-I detailed notes
95-6-J	Construct 4-level ramp system	✓	✓	○	✖	✖	✖	N/A	✓	No	Refer to Appendix for Alternative 95-6-J detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

This alternative would realign the ramps described above to eliminate the existing broken-back curves and to provide two-lane ramps. The acceleration and deceleration lanes would also be extended. This alternative would address issues B, D, E, G, H, J, K and M identified previously. A concept plan has been developed for Alternative 95-6-C and is included in the Appendix.

Alternative 95-6-D

Alternative 95-6-D would construct a two lane collector-distributor road into the median along I-95 northbound and southbound. The collector-distributor road would handle the I-95 on- and off-ramp maneuvers. Vehicles travelling through along I-95 northbound or southbound would not interact with Exit 6 ramp maneuvers, except at the collector-distributor road diverge and merge points. This alternative would address issues B through W identified previously. A concept plan has been developed for Alternative 95-6-D and is included in the Appendix.

Alternative 95-6-E

Alternative 95-6-E would discontinue West Street over I-495 and construct cul-de-sacs to local roadways that currently access West Street in the vicinity. The alternative would only be advanced in conjunction with another alternative that would impact West Street.

Alternative 95-6-F

Alternative 95-6-F would replace the I-95 northbound to I-495 northbound loop ramp with a high-speed (70 mph) directional, two-lane ramp. This alternative would address issues A, I, P, Q, S, U and W identified previously. A concept plan has been developed for Alternative 95-6-F and is included in the Appendix.

Alternative 95-6-G

Alternative 95-6-G would replace the I-495 southbound to I-95 northbound loop ramp with a high-speed (70 mph) directional, two-lane ramp. This alternative would address issues A, C, N, T, and U identified previously. A concept plan has been developed for Alternative 95-6-G and is included in the Appendix.

Alternative 95-6-H

Alternative 95-6-H would replace the I-95 southbound to I-495 southbound loop ramp with a high-speed (70 mph) directional, two-lane ramp. This alternative would address issues A, L, R, T, and V identified previously. A concept plan has been developed for Alternative 95-6-H and is included in the Appendix.

Alternative 95-6-I

Alternative 95-6-I would replace the I-495 northbound to I-95 southbound loop ramp with a high-speed (70 mph) directional, two-lane ramp. This alternative would address issues A, F, O, S, V and W identified previously. A concept plan has been developed for Alternative 95-6-I and is included in the Appendix.

Alternative 95-6-J

Alternative 95-6-J would construct a four-level ramp system. Under this alternative, the following loop ramps would be replaced with a four-tiered, high-speed directional, two-lane ramp system:

- I-95 northbound to I-495 northbound
- I-95 southbound to I-495 southbound
- I-495 southbound to I-95 northbound
- I-495 northbound to I-95 southbound

All outside ramps would remain in place. This alternative would address issues A, C, F, I, L, N, O, P, Q, R, S, T, U, V, andW identified previously. A concept plan has been developed for Alternative 95-6-J and is included in the Appendix

4.4.7 I-95: Exit 7/Route 140

Several geometric, safety, and operational issues have been identified at I-95 Exit 7 (Route 140). The issues include:

A. All loop ramps meet the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. All outer ramps meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

C. The northbound off-ramp to Route 140 southbound has 450 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

D. The southbound off-ramp to Route 140 northbound has 450 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

E. The northbound on-ramp from Route 140 southbound has 840 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

F. The northbound on-ramp from Route 140 northbound has 725 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

G. The southbound on-ramp from Route 140 northbound has 845 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

H. The southbound on-ramp from Route 140 southbound has 450 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

I. A “Littering Prohibited” sign blocks the ramp advisory speed sign at the southbound off-ramp to Route 140.

J. The intersection of Route 140 at Forbes Boulevard crash rate (1.24) exceeds MassDOT average crash rate (0.84).

K. The I-95 northbound Exit 7A and 7B on-ramps operate at LOS E/F the AM currently and will degrade to LOS F in the future.

L. The I-95 southbound Exit 7A and 7B on-ramps operate at LOS E/F the PM currently and will degrade to LOS F in the future.

M. The I-95 northbound Exit 7A off-ramp operates at LOS E in the AM under existing and future conditions.

N. The I-95 southbound Exit 7A and 7B off-ramps operate at LOS F/D the PM currently and will degrade to LOS F in the future.

O. The weaving segment along I-95 southbound at Exit 7 operates at LOS E and will degrade to LOS F in the PM in the future.

P. Route 140 at Forbes Boulevard currently operates at LOS D/F in the AM/PM and will degrade to LOS F in both the AM/PM in the future.

Q. The Route 140 at Walnut Street eastbound and westbound approaches operate at LOS F during the AM and PM in the existing and future conditions.

R. The Route 140 at I-95 northbound Exit 7A off-ramp south-eastbound approach operates at LOS F during the AM and PM in the existing and future conditions.

S. The Route 140 at I-95 southbound Exit 7A off-ramp south-eastbound approach operates at LOS F during the PM under existing and future conditions.

T. The Route 140 at I-95 northbound Exit 7B off-ramp north-westbound approach will degrade to LOS F in the AM and PM under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-8 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimate for each alternative is presented in the Appendix.

Alternative 95-7-A

Alternative 95-7-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-7-B

To meet current design standards, the following four ramp acceleration/ deceleration lanes would be extended at Exit 7:

- I-95 northbound off-ramp to Route 140 southbound would be extended from 450 feet to 520 feet
- I-95 southbound off-ramp to Route 140 northbound would be extended from 450 feet to 520 feet
- I-95 northbound on-ramp from Route 140 northbound would be extended from 725 feet to 1,350 feet
- I-95 southbound on-ramp from Route 140 southbound would be extended from 450 feet to 1,350 feet

It should be noted that the I-95 northbound on-ramp from Route 140 southbound and the I-95 southbound on-ramp from Route 140 northbound are also deficient (840 and 845 feet are currently provided respectively, 1,350 feet are required). However, the downstream off-ramp deceleration lanes prohibit lengthening of the acceleration lanes. This alternative would address issues C, D, F, and H identified previously. A concept plan has been developed for Alternative 95-7-B and is included in the Appendix.

Alternative 95-7-C

Alternative 95-7-C would install a fully actuated traffic signal at the intersection of Route 140 at a relocated Walnut Street (AM peak hour signal warrant met). Walnut Street would be relocated opposite the existing MassDOT salt shed along Route 140 to provide for a 4-way intersection. The existing Walnut Street would be terminated and a Cul de Sac would be provided. No geometric improvements are proposed along the Route 140 interchange as part of this alternative. This alternative would address issue Q identified previously.

Alternative 95-7-D

Alternative 95-7-D would restrict Fisher Street to right-in/right-out. The signal at the intersection of Fisher Street at Route 1 is approximately 600 feet south of the nearest I-95 Exit 7 ramp. To improve progression and limit vehicle conflicts along Route 140, restricting Fisher Street to right-turn in/right-turn out only was considered. In concert with this, the existing signal would be removed from the intersection, pending MassDOT approval, and the median would be closed.

Table 4-8 I-95 Exit 7 (Route 140) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-7-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-7-A detailed notes
95-7-B	Extend acceleration/deceleration lanes to meet current design standards (6 ramps)	○	✓	○	○	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-7-B detailed notes
95-7-C	Signalize intersection of Route 140 at relocated Walnut Street (if warranted)	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-7-C detailed notes
95-7-D	Restrict Fisher Street to right-in/right-out	○	○	○	✖	○	○	N/A	○	Yes	Refer to Appendix for Alternative 95-7-D detailed notes
95-7-E	Optimize existing signal timings/phasings at intersection of Route 140 and Forbes Boulevard	✓	○	○	○	○	○	N/A	○	Yes	Refer to Appendix for Alternative 95-7-E detailed notes
95-7-F	Assess lane usage efficiency at intersection of Route 140 and Forbes Boulevard	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 95-7-F detailed notes
95-7-G	Construct SPUI interchange	✓	○	○	○	○	✖	N/A	○	No	Refer to Appendix for Alternative 95-7-G detailed notes
95-7-H	Construct partial cloverleaf interchange; eliminate loop ramps accommodating off-ramp movements; signalize intersections (if warranted)	✓	○	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 95-7-H detailed notes
95-7-I	Construct partial cloverleaf interchange; eliminate loop ramps accommodating on-ramp movements; signalize intersections (if warranted)	✓	○	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 95-7-I detailed notes
95-7-J	Construct diamond interchange; eliminate cloverleaf ramps; signalize intersections	✓	○	○	○	○	○	N/A	✓	No	Refer to Appendix for Alternative 95-7-J detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 95-7-E

Alternative 95-7-E would optimize existing signal timings/phasings at intersection of Route 140 and Forbes Boulevard. Signal phasing structure would generally remain the same with right-turn overlaps introduced where appropriate. No geometric improvements are proposed as part of this alternative. This alternative would address issue P identified previously.

Alternative 95-7-F

Alternative 95-7-F assessed lane usage efficiency at the intersection of Route 140 and Forbes Boulevard. It was determined that the existing lane usage was designed to accommodate queuing vehicles during AM and PM peak hours. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 95-7-G

Alternative 95-7-G would reconfigure the I-95 interchange at Exit 7 by constructing a SPUI. A SPUI is similar to a diamond interchange, but has the advantage of allowing opposing left turns to proceed simultaneously. The design also compresses the two intersections of a traditional diamond interchange into one single intersection over or under the free-flowing roadway. In this case, I-95 would remain free flow and all ramp movements would come to one intersection along Route 140 below I-95. This alternative would address issues A through H, O, R, and S identified previously.

Alternative 95-7-H

Alternative 95-7-H would construct a partial cloverleaf interchange. The existing cloverleaf ramps in the southwest and northeast quadrants accommodating I-95 northbound and southbound off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A, K, L, O, S and T identified previously. A concept plan has been developed for Alternative 95-7-H and is included in the Appendix.

Alternative 95-7-I

Alternative 95-7-I would construct a partial cloverleaf interchange. The existing cloverleaf ramps in the southeast and northwest quadrants accommodating I-95 northbound and southbound on-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A, E, G, and O identified previously. A concept plan has been developed for Alternative 95-7-I and is included in the Appendix.

Alternative 95-7-J

Alternative 95-7-J would construct a diamond interchange in all quadrants. All existing ramps accommodating I-95 northbound and southbound on- and off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A through H, O, R, S, and T identified previously. A concept plan has been developed for Alternative 95-7-J and is included in the Appendix.

4.4.8 I-95: Exit 8/ South Main Street/Mechanic Street

Several geometric, safety, and operational issues have been identified at I-95 Exit 8 (South Main Street/Mechanic Street). The issues include:

A. The northbound on-ramp meets the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. All other ramps meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

C. The northbound off-ramp has 300 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

D. The northbound on-ramp has 950 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

E. The southbound off-ramp has 280 feet of deceleration length; however, 520 feet is required to meet MassDOT standards.

F. The southbound on-ramp has 1,125 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

G. The Hill Street/Cheryl Drive intersection and several driveways are located within 500 feet of the interchange.

H. The intersection of Mechanic Street at Oak Street crash rate (1.10) exceeds MassDOT average crash rate (0.84).

I. I-95 northbound Exit 8 on-ramp operates at LOS E the AM currently and will degrade to LOS F in the future.

J. I-95 southbound Exit 8 on-ramp will degrade to LOS E in the PM in the future.

K. I-95 northbound Exit 8 off-ramp operates at LOS E the AM under existing and future conditions.

L. I-95 southbound Exit 8 off-ramp operates at LOS E the PM currently and will degrade to LOS F in the future.

M. South Main Street at I-95 northbound ramps will degrade to LOS E in the PM under future conditions.

N. Mechanic Street at I-95 southbound ramps southbound approach currently operates at LOS F in the PM; planned signal installation will improve operations.

O. Mechanic Street at Oak Street will degrade to LOS F in the PM under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-9 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-8-A

Alternative 95-8-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-8-B

To meet current design standards, the following four ramp acceleration/ deceleration lanes would be extended at Exit 8:

- I-95 northbound off-ramp would be extended from 300 feet to 520 feet
- I-95 northbound on-ramp would be extended from 950 feet to 1,350 feet
- I-95 southbound off-ramp would be extended from 280 feet to 520 feet
- I-95 southbound on-ramp would be extended from 1,125 feet to 1,350 feet

This alternative would address issues C, D, E, and F identified previously. A concept plan has been developed for Alternative 95-8-B and is included in the Appendix.

Alternative 95-8-C

Alternative 95-8-C would optimize the existing signal timings/phasings at the intersection of South Main Street and I-95 northbound ramps. Also, a protected westbound left-turn phase was added to the overall signal phasing. The alternative would also optimize the cycle length at the intersection of Mechanic and Oak Street. This alternative would address issue M identified previously.

Alternative 95-8-D

Alternative 95-8-D assessed lane usage efficiency at the intersections of Mechanic Street and Oak Street and South Main Street and I-95 northbound ramps. A review and analysis of potential lane usage changes yielded no measureable operational improvements. The alternative was therefore discarded from further consideration.

Alternative 95-8-E

Alternative 95-8-E would increase the number of access points to the proposed Sharon Commons development. The Sharon Commons site is located to the east of I-95, just north of South Main Street with primary access to be provided via Old Post Road. Additional access points would help reduce congestion at the signals along South Main Street.

Alternative 95-8-F

Alternative 95-8-F would replace the existing I-95 southbound on-ramp loop ramp with a new slip ramp. The existing signal would be modified to accommodate the new ramp. This alternative would address issues B and F identified previously. A concept plan has been developed for Alternative 95-8-F and is included in the Appendix.

Table 4-9 I-95 Exit 8 (South Main Street/Mechanic Street) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-8-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 95-8-A detailed notes
95-8-B	Extend acceleration/deceleration lanes to meet current design standards (4 ramps)	✓	✓	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-8-B detailed notes
95-8-C	Optimize existing signal timings/phasings at intersections of Mechanic Street and Oak Street and South Main Street and I-95 NB Ramps	✓	O	O	✓	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-8-C detailed notes
95-8-D	Assess lane usage efficiency at intersections of Mechanic Street and Oak Street at South Main Street and I-95 NB Ramps	O	O	O	✖	O	O	N/A	O	Yes	Refer to Appendix for Alternative 95-8-D detailed notes
95-8-E	Increase access points to Sharon Commons development	✓	O	✓	✖	✖	O	N/A	O	Yes	Refer to Appendix for Alternative 95-8-E detailed notes
95-8-F	South Main Street to I-95 SB: Construct new slip ramp; remove existing loop ramp; modify signal (to be installed by others)	✖	O	O	✖	✖	O	N/A	O	Yes	Refer to Appendix for Alternative 95-8-F detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.4.9 I-95: Exit 9/Route 1

Several geometric, safety, and operational issues have been identified at I-95 Exit 9 (Route 1). The issues include:

A. The southbound off-ramp has 260 feet of deceleration length; however, 340 feet is required to meet MassDOT standards.
B. The southbound on-ramp has 400 feet of acceleration length; however, 1,000 feet is required to meet MassDOT standards.
C. I-95 northbound Exit 9 on-ramp will degrade to LOS E in the AM.
D. I-95 southbound Exit 9 on-ramp operates at LOS E the PM currently and will degrade to LOS F in the future.
E. I-95 northbound Exit 9 off-ramp operates at LOS E the AM currently and will degrade to LOS F in the future.
F. I-95 southbound Exit 9 off-ramp operates at LOS E in the PM under existing and future conditions.
G. The weaving segment along Route 1 northbound operates at LOS E/C and will degrade to LOS F/E in the AM/PM future conditions.
H. The weaving segment along Route 1 southbound operates at LOS F under existing and future conditions in the PM.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-10 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-9-A

Alternative 95-9-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-9-B

To meet current design standards, the following two ramp acceleration/ deceleration lanes would be extended at Exit 9:

- I-95 southbound off-ramp would be extended from 260 feet to 340 feet
- I-95 southbound on-ramp would be extended from 400 feet to 1,000 feet

This alternative would address issues A and B identified previously. A concept plan has been developed for Alternative 95-9-B and is included in the Appendix.

Alternative 95-9-C

Alternative 95-9-C considered constructing a Park and Ride along Route 1 southbound, north of the I-95 interchange. Constructing a Park and Ride lot at this location would require coordination with private land owners. A Park and Ride lot in this location could provide direct access for commuters to I-95 and Route 1.

Alternative 95-9-D

Alternative 95-9-D considered constructing a Park and Ride along Route 1 northbound, between Old Post Road and the I-95 interchange. Constructing a Park and Ride lot at this location would require coordination with private land owners. A Park and Ride lot in this location could provide direct access for commuters to I-95 and Route 1.

Alternative 95-9-E

Alternative 95-9-E would construct a collector-distributor road along Route 1 southbound to accommodate I-95 ramp movements. Route 1 would be widened to accommodate this improvement. No improvements to I-95 or to Route 1 northbound are included in this alternative. The alternative would address issue H identified previously.

Alternative 95-9-F

Alternative 95-9-F would re-construct Route 1 to align northbound and southbound side-by-side with a new ramp structure connecting the two roadways. This alternative, which would prioritize Route 1 at the potential detriment of I-95, would not improve operations enough to offset the high capital costs associated with a project of this size.

Alternative 95-9-G

Alternative 95-9-G would construct a new bridge structure and signal along Route 1 to accommodate all Route 1 and I-95 ramp movements. This alternative would address issues G and H identified previously. A concept plan has been developed for Alternative 95-9-G and is included in the Appendix.

Alternative 95-9-H

The Route 1 Safety Projects FEIR[12] investigated a number of options for this interchange. The report's preferred alternative includes maintaining the current alignment features of the interchange but has additional ramp structures to eliminate weaves and improve capacity. Included in this alternative is the construction of a slip ramp from Old Post Road to I-95 southbound. In this study, the option is identified as Alternative 95-9-H. This alternative would address issues A, B, G, and H identified previously. A concept plan has been developed for Alternative 95-9-H and is included in the Appendix.

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Table 4-10 I-95 Exit 9 (Route 1) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-9-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 95-9-A detailed notes
95-9-B	Extend acceleration/deceleration lanes to meet current design standards (2 ramps)	O	✓	O	✖	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-9-B detailed notes
95-9-C	Construct Park and Ride Lot along Route 1 SB, north of interchange with I-95	O	O	✓	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-9-C detailed notes
95-9-D	Construct Park and Ride Lot along Route 1 NB, between Old Post Road and interchange with I-95	O	O	✓	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-9-D detailed notes
95-9-E	Construct C-D roadway	O	✓	O	✖	O	O	N/A	O	Yes	Refer to Appendix for Alternative 95-9-E detailed notes
95-9-F	Realign Route 1 NB and SB side-by-side	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 95-9-F detailed notes
95-9-G	Construct new traffic signal along Route 1 to handle all traffic movements	O	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 95-9-G detailed notes
95-9-H	Realign I-95 NB and SB off-ramps to eliminate weaving movements along Route 1; construct I-95 SB on-ramp from Old Post Road (Route 1 Safety Projects FEIR Preferred Alternative)	✓	O	O	✓	✖	O	N/A	✓	No	Refer to Appendix for Alternative 95-9-H detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.4.10 I-95: Exit 10/Coney Street

Several geometric, safety, and operational issues have been identified at I-95 Exit 10 (Coney Street). The issues include:

A. The Joseph Lane intersection and several driveways are located within 500 ft of the interchange.

B. I-95 northbound Exit 10 on-ramp will degrade to LOS F in the AM in the future.

C. I-95 southbound Exit 10 off-ramp operates at LOS E in the PM currently and will degrade to LOS F in the future.

D. The westbound approach of the Coney Street at I-95 southbound off-ramp intersection operates at LOS F in the PM under existing and future conditions.

E. The eastbound approach of the Coney Street at Rustic Street intersection operates at LOS E in the AM under existing conditions and will degrade to LOS F.

F. The eastbound and westbound approaches of the Coney Street at Rustic Street intersection operate at LOS F in the PM under existing and future conditions.

G. Exit 10 is only a partial interchange serving traffic headed to and from I-95 North. Having a partial interchange reduces mobility and economic development potential and is not in line with FHWA policies.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-11 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-10-A

Alternative 95-10-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-10-B

Alternative 95-10-B would construct two new ramps to the Exit 10 interchange: a northbound on-ramp and a southbound off-ramp. The new ramps will create two, four legged intersections that would be signalized. Coney Street would be upgraded to two lanes in each direction to Route 1. Route 1 southbound at Coney Street would be upgraded to provide dual left-turn lanes. This alternative would address issue D identified previously. A concept plan has been developed for Alternative 95-10-B and is included in the Appendix.

Alternative 95-10-C

Alternative 95-10-C would construct two new ramps to the Exit 10 interchange: a northbound on-ramp and a southbound off-ramp. The new ramps will create two, four legged intersections that would be controlled by roundabouts. Coney Street would be upgraded to two lanes in each direction to Route 1. Route 1 southbound at Coney Street would be upgraded to provide dual left-turn lanes. This alternative would address issue D identified previously. A concept plan has been developed for Alternative 95-10-C and is included in the Appendix.

Alternative 95-10-D

Alternative 95-10-D would signalize the intersection of Coney Street at the I-95 southbound off-ramp. This location meets peak hour signal warrants. No geometric improvements are proposed at this location. This alternative would address issue D identified previously.

Table 4-11 I-95 Exit 10 (Coney Street) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-10-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-10-A detailed notes
95-10-B	Complete diamond interchange; signalize intersections; upgrade Coney Street to Route 1	✓	○	○	✖	✖	✖	N/A	✓	No	Refer to Appendix for Alternative 95-10-B detailed notes
95-10-C	Construct roundabouts instead of traffic signals at new diamond ramp intersections with Coney Street	✓	✓	○	✖	✖	✖	N/A	✓	No	Refer to Appendix for Alternative 95-10-C detailed notes
95-10-D	Signalize intersection of Coney Street at I-95 SB off-ramp (if warranted)	✓	✓	○	✓	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-10-D detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.4.11 I-95: Exit 11/Neponset Street

Several geometric, safety, and operational issues have been identified at I-95 Exit 11 (Neponset Street). The issues include:

A. All ramps meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. The northbound off-ramp to Neponset Street eastbound is posted at 35 mph.

C. The northbound on-ramp from Neponset Street eastbound has 855 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

D. The northbound on-ramp from Neponset Street westbound has 720 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

E. The southbound on-ramp from Neponset Street westbound has 855 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

F. The southbound on-ramp from Neponset Street eastbound has 240 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

G. The Norton Drive intersection and several driveways are located within 500 feet of the interchange.

H. I-95 northbound Exit 11A on-ramp operates at LOS E the AM currently and will degrade to LOS F in the future conditions.

I. I-95 northbound Exit 11B on-ramp will degrade to LOS E in the AM under future conditions.

J. I-95 southbound Exit 11B and 11A on-ramps operate at LOS F under existing and future conditions in the PM.

K. I-95 northbound Exit 11A off-ramp operates at LOS E the AM currently and will degrade to LOS F in the future conditions.

L. I-95 northbound Exit 11B off-ramp will degrade to LOS F in the AM and PM under future conditions.

M. I-95 southbound Exit 11B and 11A off-ramps operate at LOS E/F the PM currently and will degrade to LOS F in the future conditions.

N. The weaving segment along I-95 northbound at Exit 11 will degrade to LOS E in the AM in the future.

O. The weaving segment along I-95 southbound at Exit 11 will degrade to LOS E in the PM in the future.

P. Neponset Street at Wedgewood Drive will degrade to LOS F in the PM in the future.

Q. The minor approaches of Neponset Street at I-95 northbound Exit 11A and Exit 11B off-ramps operate at LOS E and will degrade to LOS F in the AM in the future.

R. The minor street approach of the intersection of Neponset Street at I-95 southbound Exit 11B off-ramps will degrade to LOS F in the future.

S. The minor approaches of Neponset Street at I-95 southbound Exits 11B and 11A off-ramps will degrade to LOS F in the PM in the future.

T. The minor approach of Neponset Street at I-95 northbound Exit 11A off-ramp will degrade to LOS E in the PM in the future.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-12 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 95-11-A

Alternative 95-11-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 95-11-B

To meet current design standards, the following two ramp acceleration lanes would be extended at Exit 11:

- I-95 southbound on-ramp from Neponset Street eastbound would be extended from 240 feet to 1,350 feet
- I-95 northbound on-ramp from Neponset Street westbound would be extended from720 feet to 1,350 feet

It should be noted that the following loop ramps are deficient but the downstream off-ramp prohibits lengthening of the acceleration lanes:

- I-95 northbound on-ramp from Neponset Street eastbound (855 feet of acceleration length are provided, 1,350 feet are required)
- I-95 southbound on-ramp from Neponset Street westbound (855 feet of acceleration length are provided, 1,350 feet are required)

This alternative would address issues D and F identified previously. A concept plan has been developed for Alternative 95-11-B and is included in the Appendix.

Table 4-12 I-95 Exit 11/ Neponset Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-11-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-11-A detailed notes
95-11-B	Extend acceleration lanes to meet current design standards (4 ramps)	○	✓	○	○	✖	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-11-B detailed notes
95-11-C	Optimize signal at Wedgewood Drive; consider improved coordination with Cherrywood Drive	✓	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 95-11-C detailed notes
95-11-D	Construct partial cloverleaf interchange; eliminate loop ramps accommodating off-ramp movements; signalize intersections (if warranted)	✓	✓	○	○	✓	○	N/A	✓	Yes	Refer to Appendix for Alternative 95-11-D detailed notes
95-11-E	Construct partial cloverleaf interchange; eliminate loop ramps accommodating on-ramp movements; signalize intersections (if warranted)	✓	✓	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 95-11-E detailed notes
95-11-F	Construct diamond interchange; eliminate cloverleaf ramps; signalize intersections	✓	✓	○	○	✖	○	N/A	✓	No	Refer to Appendix for Alternative 95-11-F detailed notes
95-11-G	Widen Neponset Street to 4 lane section from I-95 SB ramps to Wedgewood Drive	✓	○	○	✖	✖	✖	N/A	✓	Yes	Refer to Appendix for Alternative 95-11-G detail notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 95-11-C

Alternative 95-11-C would improve the signal timings/phasings at the intersection of Wedgewood Drive and would be optimized and coordinated with the Cherrywood Drive location. This alternative would address issue P identified previously. A concept plan has been developed for Alternative 95-11-C and is included in the Appendix.

Alternative 95-11-D

Alternative 95-11-D would construct a partial cloverleaf interchange. The existing ramp in the northeast quadrant accommodating I-95 northbound off-ramp movement would be eliminated. A signal would be installed at the base of the existing northbound off-ramp to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A, B, H, N, Q and T identified previously. A concept plan has been developed for Alternative 95-11-D and is included in the Appendix.

Alternative 95-11-E

Alternative 95-11-E would construct a partial cloverleaf interchange. The existing cloverleaf of ramps in the southeast and northwest quadrants accommodating I-95 northbound and southbound on-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A, D, F, M, N, and O identified previously. A concept plan has been developed for Alternative 95-11-E and is included in the Appendix.

Alternative 95-11-F

Alternative 95-11-F would construct a diamond interchange in all quadrants. All existing ramps accommodating I-95 northbound and southbound on- and off-ramp movements would be eliminated. Signals would be installed at the base of the new diamond ramps to accommodate left-turn movements. Peak hour signal warrants are met for this location. This alternative would address issues A through I, N, O, Q, R, S, and T identified previously. A concept plan has been developed for Alternative 95-11-F and is included in the Appendix.

Alternative 95-11-G

Alternative 95-11-G would widen Neponset Street to two lanes in each direction from the I-95 SB ramps through its intersection with Wedgewood Drive. This alternative would address issue P identified previously. A concept plan has been developed for Alternative 95-11-G and is included in the Appendix.

4.4.12 I-95: Dedham Street Slip Ramp

Aside from the No-Build/Do-Nothing scenario, presented in Table 4-13, no other alternatives were considered for this interchange. It should be noted that there are proposed improvements to this location being studied as part of the I-95/Route 128/I-93 interchange project, including:

- Providing access from Dedham Street westbound to existing I-95 southbound on-ramp
- Constructing an off-ramp from I-95 northbound with access to Dedham Street eastbound and westbound
- Reconstructing Dedham Street bridge
- Signalizing ramp intersections with Dedham Street

4.4.13 I-495: Exit 11/12/Route 140

Several geometric, safety, and operational issues have been identified at I-495 Exit 11/12 (Route 140). These issues include:

A. The southbound off-ramp to Route 140 northbound meets the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. The intersections of South Main Street with Gladiola Terrace, Reservoir Street, and several driveways are located within 500 ft of the interchange.

C. The intersection of Route 140 at the Comcast Center driveway crash rate (1.56) exceeds MassDOT average crash rate (0.59).

D. The intersection of Route 140 at School Street crash rate (1.25) exceeds MassDOT average crash rate (0.84).

E. Route 140 at School Street currently operates at LOS E in the PM and will degrade to LOS F under future conditions.

F. The Route 140 at I-495/C-D roadway southbound off-ramp eastbound approach currently operates at LOS F in the PM; planned signal installation will improve operations.

G. The Route 140 at the Comcast Center driveway eastbound left-turn is projected to degrade to LOS E in the PM under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-14 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Table 4-13 I-95 Slip Ramp (Dedham Street) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
95-Slip-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 95-Slip-A detailed notes

○ Neutral Impact

n/a not applicable

Table 4-14 I-495 Exit 11/12 (Route 140) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
495-11/12-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 495-11/12-A detailed notes
495-11/12-B	Optimize existing signal timings/phasings at intersection of Route 140 and School Street	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 495-11/12-B detailed notes
495-11/12-C	Assess lane usage efficiency at intersection of Route 140 and School Street	✓	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 495-11/12-C detailed notes
495-11/12-D	Formalize Route 140 NB U-turn movement at School Street intersection	✓	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 495-11/12-D detailed notes

✓ Positive Impact

○ Neutral Impact

✖ Negative Impact

n/a not applicable

Alternative 495-11/12-A

Alternative 495-11/12-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 495-11/12-B

Alternative 495-11/12-B considered optimizing existing signal timings/phasings at intersection of Route 140 and School Street. No signal timing/phasings adjustments were identified that would measurably improve operations without geometric changes needed. Therefore, no improvements proposed under this alternative and it was discarded from further consideration.

Alternative 495-11/12-C

Alternative 495-11/12-C would modify the lane usage at the intersection of Route 140 at School Street. The dual Route 140 northbound left-turn lanes would be converted to an exclusive u-turn lane and an exclusive left-turn lane. The School Street eastbound approach would be changed to a through and shared through/channelized right-turn with storage by decreasing the right-turn island. This alternative would address issue E identified previously.

Alternative 495-11/12-D

Alternative 495-11/12-D would formalize and provide signage for the Route 140 northbound u-turn movement at School Street intersection. The Route 140 northbound u-turn movement accommodates I-495 northbound trips destined for Route 140 southbound. To accommodate u-turning maneuvers by a WB-50 truck, the island on the eastbound Route 140 approach would be modified, the stop line relocated and the curb adjusted. This alternative would address issue E identified previously. A concept plan has been developed for Alternative 495-11/12-D and is included in the Appendix.

4.4.14 I-495: Exit 14/Route 1

Several geometric, safety, and operational issues have been identified at I-495 Exit 14 (Route 1). These issues include:

A. The northbound off-ramp to Route 1 northbound, the northbound on-ramp from Route 1 southbound, the southbound on-ramp from Route 1 northbound, and the southbound on-ramp from Route 1 northbound meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.

B. The northbound on-ramp from Route 1 northbound, the northbound off-ramp to Route 1 southbound, the southbound off-ramp to Route 1 southbound, and the southbound off-ramp to Route 1 northbound meet the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph for MassDOT design standards.

C. The northbound on-ramp from Route 1 northbound has 990 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

D. The northbound on-ramp from Route 1 southbound has 875 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

E. The southbound off-ramp to Route 1 southbound has 335 feet of deceleration length; however, 540 feet is required to meet MassDOT standards.

F. The southbound on-ramp from Route 1 southbound has 920 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

G. The southbound on-ramp from Route 1 northbound has 1,200 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.

H. The Madison Street intersection is located within 500 feet of the interchange.

I. I-495 southbound Exit 14A off-ramp will degrade to LOS F in the AM under future conditions.

J. I-495 southbound Exit 14A off-ramp operates at LOS E the PM currently and will degrade to LOS F in the future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-15 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 495-14-A

Alternative 495-14-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Table 4-15 I-495 Exit 14 (Route 1) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
495-14-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 495-14-A detailed notes
495-14-B	Extend acceleration/deceleration lanes to meet current design standards (5 ramps)	○	✓	○	○	✖	✓	N/A	✓	N/A	Refer to Appendix for Alternative 495-14-B detailed notes
495-14-C	Widen Route 1 to provide three full lanes under I-495	○	✓	○	○	○	✓	N/A	○	Yes	Refer to Appendix for Alternative 495-14-C detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 495-14-B

To meet current design standards, the following ramp acceleration/ deceleration lanes would be extended at Exit 14:

- I-495 northbound on-ramp from Route 1 southbound would be extended from 875 feet to 1,350 feet
- I-495 southbound off-ramp to Route 1 southbound would be extended from 335 feet to 540 feet
- I-495 southbound on-ramp from Route 1 northbound would be extended from 1,200 feet to 1,350 feet

It should be noted that the I-495 northbound on-ramp from Route 1 northbound and I-495 southbound on-ramp from Route 1 southbound are also deficient (920 and 990 feet are currently provided respectively, 1,350 feet are required). However, the downstream off-ramp deceleration lanes prohibit lengthening of the acceleration lanes. This alternative would therefore address issues D, E, and G identified previously. A concept plan has been developed for Alternative 495-14-B and is included in the Appendix.

Alternative 495-14-C

Alternative 495-14-C would widen Route 1 to three full lanes between the I-495 ramps. This would extend the weaving distance along Route 1 between the I-495 ramps. Route 1 would essentially consist of two through lanes and an auxiliary lane through this section. Route 1 would be widened into the existing median to provide the three full lanes. A concept plan has been developed for Alternative 495-14-C and is included in the Appendix.

4.4.15 I-495: Exit 15/Exit 1A

Several geometric, safety, and operational issues have been identified at I-495 Exit 15 (Route 1A). These issues include:

A. The northbound on-ramp meets the design criteria for only 25 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.
B. All other ramps meet the design criteria for only 30 mph. All ramp roadways should be designed for a minimum of 35 mph per MassDOT design standards.
C. The northbound off-ramp has 340 feet of deceleration length; however, 540 feet is required to meet MassDOT standards.
D. The northbound on-ramp has 430 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.
E. The southbound off-ramp has 200 feet of deceleration length; however, 540 feet is required to meet MassDOT standards.
F. The southbound on-ramp has 525 feet of acceleration length; however, 1,350 feet is required to meet MassDOT standards.
G. Route 1A is an undivided four-lane roadway through the interchange area.
H. The Nickerson Street intersection and driveways are located within 500 feet of the interchange.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-16 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

In order to effectively implement improvements along Route 1A and other locations within this area, it is important that the State, towns, and developers increase the amount of coordination between all parties. Traffic growth at this interchange is being driven by land use decisions at the Town and developer level. It is important that supportable long-range plans be developed that are both feasible, constructible, and are jointly arrived at in order to be effective in handling the long-term growth that is occurring in this area.

Alternative 495-15-A

Alternative 495-15-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 495-15-B

To meet current design standards, the following ramp acceleration/ deceleration lanes would be extended at Exit 15:

- I-495 northbound off-ramp would be extended from 340 feet to 540 feet
- I-495 northbound on-ramp would be extended from 430 feet to 1,350 feet
- I-495 southbound off-ramp would be extended from 200 feet to 540 feet
- I-495 southbound on-ramp would be extended from 525 feet to 1,350 feet

This alternative would therefore address issues C, D, E, and F identified previously. A concept plan has been developed for Alternative 495-15-B and is included in the Appendix.

Alternative 495-15-C

Alternative 495-15-C would widen Route 1A to three full lanes between the I-495 ramps. Route 1A would essentially consist of two through lanes and an auxiliary lane through this section. A concept plan has been developed for Alternative 495-15-C and is included in the Appendix.

Table 4-16 I-495 Exit 15 (Route 1A) Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
495-15-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 495-15-A detailed notes
495-15-B	Extend acceleration/deceleration lanes to meet current design standards (4 ramps)	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 495-15-B detailed notes
495-15-C	Widen Route 1A through interchange area	✓	○	○	✖	✖	✖	N/A	○	Yes	Refer to Appendix for Alternative 495-15-C detailed notes
495-15-D	Provide other access for Outlet-related traffic along Route 1A, south of existing Outlet driveway	✓	○	○	✖	✖	✖	N/A	○	Yes	Refer to Appendix for Alternative 495-15-D detailed notes
495-15-E	Provide Route 121 connection to Route 1A to alleviate Outlet-related traffic at interchange	✓	○	○	✖	✖	✖	N/A	✖	Yes	Refer to Appendix for Alternative 495-15-E detailed notes
495-15-F	Construct I-495 NB and SB on-ramps to eliminate left-turns to cloverleaf ramps	✓	○	○	✖	✖	✖	N/A	✖	Yes	Refer to Appendix for Alternative 495-15-F detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

Alternative 495-15-D

Alternative 495-15-D would provide an additional access point for Outlet-related traffic along Route 1A. This access point would likely be provided south of the existing Outlet driveway. It would help relieve congestion at exiting intersection.

Alternative 495-15-E

Alternative 495-15-E would provide an additional access point for Outlet-related traffic along Route 121. This access point could help to alleviate Outlet-related traffic at the I-495 interchange and provide alternative route for local traffic through the area.

Alternative 495-15-F

Alternative 495-15-F would construct slip on-ramps to I-495 northbound and southbound to eliminate the left-turn movements at the existing cloverleaf ramps. A concept plan has been developed for Alternative 495-15-F and is included in the Appendix.

4.5 Route 1 Intersection Alternatives

The Route 1 intersection improvement alternatives focused on addressing geometric deficiencies, relieving congestion at specific intersections, and improving safety. The potential short- and long-term improvement alternatives for each intersection are described in detail below. Concept plans have been developed for certain alternatives and are included in the Appendix.

4.5.1 Route 1 at Route 123

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Route 123. These issues include:

A. The intersection crash rate (2.15) exceeds MassDOT average crash rate (0.84).
B. During the PM, intersection will operate at LOS E under future conditions.
C. During the PM, the Route 123 eastbound and Route 1 southbound approaches have movements that operate at LOS E/F under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-17 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-1-A

Alternative 1-1-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-1-B

Alternative 1-1-B would prohibit southbound left turns from Route 1 and remove that phase from the traffic signal. Route 1 would need to be restriped and signage would need to be installed to enforce the prohibited movement. This alternative would address issue B identified previously.

Alternative 1-1-C

Alternative 1-1-C would optimize the existing signal timings/phasings at the intersection. No changes to phase structure are proposed as part of this alternative. Also, no geometric changes proposed as part of this alternative. This alternative would address issue B identified previously.

Alternative 1-1-D

Alternative 1-1-D assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-1-E

Alternative 1-1-E would implement access management strategies to parcels in the vicinity of the intersection. These improvements could reduce the number of curb cuts along Route 1. No improvements to the intersection itself are proposed under this alternative.

Alternative 1-1-F

Alternative 1-1-F considered re-timing and re-phasing the three intersections that accommodate Route 1, Route 1A, and Route 123. In addition to signal modifications, the following lane use changes are also proposed:

- At the intersection of Route 1 at Route 123, the Route 123 eastbound approach would be changed from two general purpose lanes to a right-turn/through lane and a left-turn only lane.
- At the intersection of Route 1A at Route 123, the Route 123 westbound approach would be changed from two general purpose lanes to a right-turn/through lane and a left-turn only lane.

Alternative 1-1-G

Alternative 1-1-G considered acquiring the land inside the "triangle" created by the three intersecting roadways and reconfiguring the three intersections that accommodate Route 1, Route 1A, and Rout 123. Based on a review of volumes and signal operations, no modifications would measurably improve operations and therefore the alternative was discarded.

Table 4-17 Route 1 at Route 123 Alternatives Evaluation Summary

		How does the Alternative address the Project Goals?									
Alternatives		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-1-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-1-A detailed notes
1-1-B	Remove Route 1 SB left-turn movement	✓	O	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-1-B detailed notes
1-1-C	Optimize existing signal timings/phasings	✓	O	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-1-C detailed notes
1-1-D	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-1-D detailed notes
1-1-E	Implement access management strategies	✓	O	O	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 1-1-E detailed notes
1-1-F	Re-time & re-phase the three signals to improve safety and coordination (Route 1/Route 1A/Route 123 "triangle")	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-1-F detailed notes
1-1-G	Acquire land inside "triangle"; reconfigure 3 intersections	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-1-G detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.2 Route 1 at Route 1A/Elmwood Street

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Route 1A/Elmwood Street. These issues include:

A. The intersection crash rate (1.19) exceeds MassDOT average crash rate (0.84).
B. During the PM, intersection operates at LOS E under existing conditions and future conditions.
C. During the PM, the Route 1 southbound and Elmwood Street westbound approaches have movements that will operate at LOS F under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-18 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-2-A

Alternative 1-2-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-2-B

Alternative 1-2-B would optimize the existing signal timings (cycle length and phase lengths). No changes to phase structure are proposed as part of this alternative. Also, no geometric changes proposed as part of this alternative. This alternative would address issue B identified previously.

Alternative 1-2-C

Alternative 1-2-C assessed lane usage efficiency at the intersection. This alternative would construct a Route 1 southbound right-turn pocket with approximately 100 feet of storage. This alternative would address issue B identified previously.

Alternative 1-2-D

Alternative 1-2-D would signalize Route 1A at Elmwood Street and coordinate it with the existing Route 1 at Route 1A/Elmwood Street signal. This alternative would address issue B identified previously.

Alternative 1-2-E

Alternative 1-2-E would create one signalized, five-legged intersection to accommodate all movements between Route 1, Route 1A and Elmwood Street.

Alternative 1-2-F

Alternative 1-2-F considered combining the Route 1, Route 1A, and Elmwood Street into one signalized intersection with a by-pass for Route 1 through traffic. In order to construct a by-pass, Elmwood Street would need to be closed which is an undesirable condition. Therefore, this alternative was discarded from further consideration.

Alternative 1-2-G

Alternative 1-2-G would construct a four-legged roundabout to accommodate all movements among Route 1and Route 1A,. Elmwood Street and Whiting Street movements would access roundabout via Route 1 and Route 1A, respectively. This alternative would address issues B and C identified previously. A concept plan has been developed for Alternative 1-2-G and is included in the Appendix.

Alternative 1-2-H

Alternative 1-2-H would construct a double roundabout sometimes called a "bowtie" or "peanut" roundabouts to accommodate all movements among Route 1, Route 1A, Whiting Street and Elmwood Street. This alternative would address issues B and C identified previously. A concept plan has been developed for Alternative 1-2-H and is included in the Appendix.

Alternative 1-2-I

Alternative 1-2-I would consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street. A new signal would be installed along Route 1 at Whiting Street. This alternative would eliminate the grass median currently separating Route 1 and Route 1A. The existing signal at Elmwood Street would be re-phased and re-timed to accommodate the new roadway alignment. This alternative would address issues B and C identified previously. A concept plan has been developed for Alternative 1-2-I and is included in the Appendix.

Alternative 1-2-J

Alternative 1-2-J would consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street. A new signal would be installed along Route 1 at Whiting Street. A by-pass for Route 1A southbound would be provided. A one-way couplet would be established with Route 1A/Elmwood Street operating one-way eastbound and Whiting Street one-way westbound. The existing signal at Elmwood Street would be re-phased and re-timed to accommodate the new alignment. This alternative would address issue B identified previously. A concept plan has been developed for Alternative 1-2-I and is included in the Appendix.

Alternative 1-2-K

Alternative 1-2-K would consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street. A new signal would be installed along Route 1 at Whiting Street. A by-pass for Route 1A southbound would be provided. The existing signal at Elmwood Street would be re-phased and re-timed to accommodate the new alignment. This alternative is different than 1-2-J because it does not establish a one-way couplet; Whiting street would be one-way westbound but Route 1A/Elmwood Street would be two way. This alternative would address issues B and C identified previously. A concept plan has been developed for Alternative 1-2-K and is included in the Appendix.

Table 4-18 Route 1 at Route 1A/Elmwood Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-2-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-2-A detailed notes
1-2-B	Optimize existing signal timings/phasings	✓	O	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-2-B detailed notes
1-2-C	Assess lane usage efficiency	✓	O	O	✖	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-2-C detailed notes
1-2-D	Signalize intersection of Route 1A at Elmwood Street and coordinate with Route 1 at Route 1A/Elmwood Street signal	✓	O	O	✓	O	✓	N/A	✓	No	Refer to Appendix for Alternative 1-2-D detailed notes
1-2-E	Create 1 signalized intersection to accommodate all movements between Route 1, Route 1A and Elmwood Street	✖	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-E detailed notes
1-2-F	Create 1 signalized intersection to accommodate all movements between Route 1, Route 1A and Elmwood Street with Route 1 by-pass of signal	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-2-F detailed notes
1-2-G	Install roundabout to accommodate all movements between Route 1, Route 1A and Elmwood Street	✓	✓	O	✖	✖	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-G detailed notes
1-2-H	Install a double roundabout	✓	✓	O	✖	✖	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-H detailed notes
1-2-I	Consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street; install new signal along Route 1 at Whiting Street	✓	O	O	✖	✖	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-I detailed notes
1-2-J	Consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street; provide Route 1A SB by-pass; install new signal along Route 1 at Whiting Street	✓	O	O	✖	✖	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-J detailed notes
1-2-K	Consolidate Route 1 and Route 1A from Elmwood Street to Whiting Street; provide Route 1A SB by-pass; install new signal along Route 1 at Whiting Street; Route 1A two-way access	✓	O	O	✖	✖	✖	N/A	O	No	Refer to Appendix for Alternative 1-2-K detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.3 Route 1 at East Street/Main Street

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at East Street/Main Street. These issues include:

A. During the AM, Main Street westbound approach operates at LOS E under existing conditions and will degrade to LOS F with greater than 120 seconds of delay in the future.

B. During the PM, East Street eastbound approach will operate at LOS F with greater than 120 seconds of delay under future conditions.

C. Accel/Decel lanes along Route 1 do not meet MassDOT standards.

To supplement the development of alternatives for this location, an origin-destination (OD) study was conducted by CTPS to determine travel patterns among Route 1, Route 140, and Route 115 in Foxborough. The results of the study indicate the majority of trips along Route 140 in the morning and evening peak periods are local trips that continue on Route 140 or access Route 115 northbound. Vehicles from Route 1 southbound are generally destined for Route 140 westbound or Route 115 northbound while the majority of vehicles from Route 1 northbound are destined for Route 140 eastbound or Route 115 northbound. The majority of Route 115 vehicles access Route 1 via Pine Street during both peak periods. Conversely, the majority of vehicles Route 1 via Pine Street are destined for Route 115 during both peak periods. The complete results of this OD study are included in the Appendix.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-19 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-3-A

Alternative 1-3-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-3-B

Alternative 1-3-B would extend median along Route 1 through the intersection. Currently the Route 1 median terminates approximately 800 feet north of the intersection. Although left turns are prohibited at this intersection, some vehicles still make left turns. If the median along Route 1 was extended through the intersection of Route 1 at East Street/Main Street, left turns would be impossible. A concept plan has been developed for Alternative 1-3-B and is included in the Appendix.

Alternative 1-3-C

Alternative 1-3-C would implement access management strategies to parcels in the vicinity of the intersection. These improvements could reduce the number of curb cuts along Route 1. No improvements to the intersection itself are proposed under this alternative.

Alternative 1-3-D

Alternative 1-3-D would improve signage along Route 1 in the vicinity of the intersection. Improved signage in the vicinity of the intersection would help alert drivers along Route 1 of merging traffic from East Street and Main Street. Additionally, updated signage would more clearly inform drivers of how to traverse the unique roadway network to access Route 1 northbound and southbound and Route 140 eastbound and westbound.

Alternative 1-3-E

Alternative 1-3-E would extend the Route 1 acceleration/ deceleration lanes. Extending the Route 1 acceleration lanes would give drivers a greater distance to accelerate before merging onto Route 1 from East Street and Main Street. Extending the Route 1 deceleration lanes would give drivers a greater distance to decelerate before diverging from Route 1 onto East Street or Main Street. A concept plan has been developed for Alternative 1-3-E and is included in the Appendix.

Alternative 1-3-F

Alternative 1-3-F would re-designate Pine Street from Route 1 to Turner Road as Route 115. This action would provide full access to Route 1 at an existing signal. This alternative would improve truck access to and from Route 1.

Alternative 1-3-G

Alternative 1-3-G considered providing a full access signal at the intersection of Route 140 at Main Street. This alternative was discarded from further consideration due to limited benefit to the study area intersection.

Alternative 1-3-H

Alternative 1-3-H would re-designate East Street/Main Street as Route 140. The intersection would be signalized and full access to/from Route 1 would be provided.

Alternative 1-3-I

Alternative 1-3-I considered constructing on-ramps from Route 140 to Route 1 northbound and southbound. The Route 1 southbound on-ramp was discarded from further consideration due to minimal demand (less than 200 vehicles per hour), right-of-way impacts and driveway spacing issues. The Route 1 northbound on-ramp is projected to carry more substantial traffic volumes (greater than 200 vehicles per hour) and would address issue A identified previously. A concept plan has been developed for Alternative 1-3-I and is included in the Appendix.

Table 4-19 Route 1 at East Street/Main Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-3-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 1-3-A detailed notes
1-3-B	Extend median through intersection	○	✓	○	✖	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-3-B detailed notes
1-3-C	Implement access management strategies	✓	○	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-3-C detailed notes
1-3-D	Improve signage	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-3-D detailed notes
1-3-E	Extend Route 1 acceleration/ deceleration lanes	○	✓	○	✖	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-3-E detailed notes
1-3-F	Re-designate Pine Street from Route 1 to Turner Road as Route 115	○	○	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-3-F detailed notes
1-3-G	Signalize intersection of Route 140 at Main Street (if warranted)	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-3-G detailed notes
1-3-H	Re-designate East Street/Main Street as Route 140; signalize intersection of new Route 140 with Route 1; provide full access to/from Route 1	✖	○	○	✖	○	○	N/A	○	Yes	Refer to Appendix for Alternative 1-3-H detailed notes
1-3-I	Provide Route 1 NB and SB on-ramps from Route 140	✓	○	○	✖	○	✖	N/A	○	Yes	Refer to Appendix for Alternative 1-3-I detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.4 Route 1 at Route 27/High Plain Street

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Route 27/High Plain Street. These issues include:

A. The intersection crash rate (1.61) exceeds MassDOT average crash rate (0.84).

B. During the AM, intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

C. During the PM, intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

D. During the AM, the Route 27 eastbound, Route 27 westbound, and Route 1 northbound approaches have movements that operate at LOS E/F under existing and future conditions.

E. During the PM, the Route 27 eastbound, Route 27 westbound, and Route 1 northbound approaches have movements that operate at LOS F under existing and future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-20 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-4-A

Alternative 1-4-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-4-B

Alternative 1-4-B would install LED/ advance warning signage along Route 1 northbound to alert drivers of a signal ahead. This alternative addresses safety but does not add capacity to the intersection.

Alternative 1-4-C

Alternative 1-4-C would implement access management strategies to parcels in the vicinity of the intersection. These improvements could reduce the number of curb cuts along Route 1. No improvements to the intersection itself are proposed under this alternative.

Alternative 1-4-D

Alternative 1-4-D would restrict right turns on red for the Route 27 eastbound approach. Right turn movements on red from Route 27 eastbound create a potential safety problem because they currently conflict with u-turning vehicles from Route 1 northbound. This alternative addresses issue A identified previously.

Alternative 1-4-E

Alternative 1-4-E considered widening the Route 27 eastbound approach. However, the Route 27 eastbound two lane approach currently extends past the shopping plaza. No further modifications measurably improved operations and therefore this alternative was discarded from further consideration.

Alternative 1-4-F

Alternative 1-4-F would widen the Route 27 westbound approach. This would consist of constructing a 250-foot storage lane for the right-turn movement. The Route 27 westbound approach would consist of a left-turn lane, a through lane, and a right-turn lane. This alternative addresses issues D and E identified previously. A concept plan has been developed for Alternative 1-4-F and is included in the Appendix.

Alternative 1-4-G

Alternative 1-4-G assessed the existing signal timings and tested modifications to cycle length and phase lengths. It was determined that signal changes would not result in measureable operational (LOS) improvements. Modifications to the signal operations at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-4-H

Alternative 1-4-H assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-4-I

Alternative 1-4-I would construct a collector-distributor roadway along Route 1 northbound, north of Route 27. This action would improve safety by providing access to businesses along Route 1 and would not impact Route 1 northbound through traffic.

Alternative 1-4-J

Alternative 1-4-J would paint/score the concrete truck u-turn areas along Route 1 northbound and southbound to more clearly define Route 1 through lanes which improves safety.

Table 4-20 Route 1 at Route 27 Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?: Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-4-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 1-4-A detailed notes
1-4-B	Install LED/ advance warning signs for signal ahead along Route 1 NB and SB	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-4-B detailed notes
1-4-C	Implement access management strategies	✓	○	○	○	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-4-C detailed notes
1-4-D	Restrict right turns on red for Route 27 EB approach	✖	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-4-D detailed notes
1-4-E	Extend 2 lane Route 27 EB approach	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-4-E detailed notes
1-4-F	Widen Route 27 WB approach	✓	○	○	✖	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-4-F detailed notes
1-4-G	Optimize existing signal timings/phasings	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-4-G detailed notes
1-4-H	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-4-H detailed notes
1-4-I	Construct C-D roadway along Route 1 NB for local access	✓	✓	○	✖	○	✖	N/A	○	Yes	Refer to Appendix for Alternative 1-4-I detailed notes
1-4-J	Paint/score concrete Route 1 NB and SB truck u-turn areas to more clearly define Route 1 through lanes	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-4-J detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.5 Route 1 at Coney Street

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Coney Street. These issues include:

A. The intersection crash rate (1.40) exceeds MassDOT average crash rate (0.84).
B. During the PM, intersection degrades to LOS F under future conditions.
C. During the PM, the Coney Street westbound and Route 1 southbound approaches have movements that operate at LOS E/F under existing and future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-21 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-5-A

Alternative 1-5-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-5-B

Alternative 1-5-B would install LED/ advance warning signage along Route 1 northbound to alter drivers of a signal ahead. This alternative does not add capacity to the intersection but improves safety as vehicles queue at the intersection.

Alternative 1-5-C

Alternative 1-5-C would paint/score the concrete truck u-turn areas along Route 1 northbound and southbound to more clearly define Route 1 through lanes to improve safety.

Alternative 1-5-D

Alternative 1-5-D would upgrade pedestrian accommodations in the vicinity of the intersection to connect neighborhood to the west to the Walpole Mall.

Alternative 1-5-E

Alternative 1-5-E would optimize existing signal timings (cycle length and phase lengths). No changes to phase structure are proposed as part of this alternative. Also, no geometric changes proposed as part of this alternative. This alternative would address issue B identified previously.

Alternative 1-5-F

Alternative 1-5-F assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-5-G

Alternative 1-5-G would construct dual Route 1 southbound left-turn lanes in conjunction with the completion of the I-95 Exit 10 interchange. The alternative would also optimize the signal at the intersection. This alternative would address issue B identified previously. A concept plan has been developed for Alternative 1-5-G and is included in the Appendix.

Table 4-21 Route 1 at Coney Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-5-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 1-5-A detailed notes
1-5-B	Install LED/ advance warning signs for signal ahead along Route 1 NB	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-5-B detailed notes
1-5-C	Paint/score concrete Route 1 NB and SB truck u-turn areas to more clearly define Route 1 through lanes	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-5-C detailed notes
1-5-D	Improve pedestrian accommodations	○	✓	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-5-D detailed notes
1-5-E	Optimize existing signal timings/phasings	✓	○	○	○	○	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-5-E detailed notes
1-5-F	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-5-F detailed notes
1-5-G	Construct dual Route 1 SB left-turn lanes (in concert with completion of I-95 Exit 10 interchange)	✓	○	○	✖	○	○	N/A	✓	Yes	Refer to Appendix for Alternative 1-5-G detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.6 Route 1 at Dean Street

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Dean Street. These issues include:

A. The intersection crash rate (1.93) exceeds MassDOT average crash rate (0.84). (Note: this was based on conditions before ramps were signalized.)

B. During the AM, intersection operates at LOS F with greater than 120 seconds of delay under existing conditions; planned upgrades will improve operations.

C. During the PM, intersection operates at LOS F with greater than 120 seconds of delay under existing conditions; planned upgrades will improve operations.

D. With improvements under future conditions, only the Dean Street eastbound approach will have movements that operate at LOS F in the AM and PM.

E. The Dean Street at Route 1 southbound off-ramp northbound approach operates at LOS F in the PM and the southbound approach operates at LOS F in the AM and PM; location will be signalized and will operate at LOS E in the AM and PM.

F. Under future conditions, the Dean Street eastbound and driveway northbound approaches will have movements that operate at LOS F in the AM and PM.

G. The Dean Street at Route 1 northbound off-ramp northbound approach operates at LOS F in the AM and PM; location will be signalized and will operate at LOS E in the PM.

H. Under future conditions, the Dean Street eastbound approach will have movements that operate at LOS F in the AM and PM.

I. Several driveways in close proximity to the intersection interfere with traffic operations and safety.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-22 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-6-A

Alternative 1-6-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-6-B

Alternative 1-6-B would improve lane markings/signage at the three intersections. to more clearly designate traffic movements. This alternative is aimed at reducing confusion for drivers traveling through the three intersections and could improve safety. No capacity enhancements are recommended as part of this alternative.

Alternative 1-6-C

Alternative 1-6-C addresses access issues at the Staples shopping plaza in the southwest corner of the Route 1 at Dean Street intersection. These improvements would benefit operations; however the improvements have not been discussed with the owners of the property on which the access issues are located. This alternative would address issue I.

Alternative 1-6-D

Alternative 1-6-D would grade separate the intersection by putting Route 1 on a structure. On-ramps to Route 1 would be constructed and off-ramps from Route 1 would utilize the existing off-ramp footprint. The two existing Dean Street signals would remain to accommodate all Dean Street and Route 1 ramp movements. This alternative would address all issues (A through H) described previously. A concept plan has been developed for Alternative 1-6-D and is included in the Appendix.

Alternative 1-6-E

Alternative 1-6-E would grade separate the intersection by putting Route 1 in a tunnel. On-ramps to Route 1 would be constructed and off-ramps from Route 1 would utilize the existing off-ramp footprint. The two existing Dean Street signals would remain to accommodate all Dean Street and Route 1 ramp movements. This alternative would address all issues (A through H) described previously. A concept plan has been developed for Alternative 1-6-E and is included in the Appendix.

Alternative 1-6-F

Alternative 1-6-F would grade separate the intersection by putting Route 1 on a structure. On- and off-ramps to Route 1 would utilize the existing off-ramp footprint. The two existing Dean Street signals would remain to accommodate all Dean Street and Route 1 ramp movements. This alternative would address all issues (A through H) described previously. A concept plan has been developed for Alternative 1-6-F and is included in the Appendix.

Alternative 1-6-G

Alternative 1-6-G considers acquiring properties inside the loop ramps to allow for future expansion of the intersection approaches and to reduce driveway conflicts within the coordinated signal system.

Table 4-22 Route 1 at Dean Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?									
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-6-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-6-A detailed notes
1-6-B	Improve lane markings/signage at three intersections	O	✓	O	O	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 1-6-B detailed notes
1-6-C	Assess Staples plaza access	O	✓	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-6-C detailed notes
1-6-D	Grade separate intersection and construct Route 1 NB and SB on-ramps from Dean Street (Route 1 on structure)	✓	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-6-D detailed notes
1-6-E	Grade separate intersection and construct Route 1 NB and SB on-ramps from Dean Street (Route 1 in tunnel)	✓	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-6-E detailed notes
1-6-F	Grade separate intersection and construct contra-flow Route 1 NB and SB on-ramps from Dean Street using existing loop ramps (Route 1 on structure)	✓	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-6-F detailed notes
1-6-G	Acquire properties inside loop ramps to allow for future expansion of intersection approaches	O	O	O	✖	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-6-G detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.7 Route 1 at Everett Street/University Avenue

Several geometric, safety, and operational issues have been identified at the intersection of Route 1 at Everett Street/University Avenue. These issues include:

A. During the AM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.
B. During the PM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.
C. During the AM, all approaches have movements that operate at LOS E/F under existing and future conditions.
D. During the PM, all approaches have movements that operate at LOS E/F under existing and future conditions.
E. Several driveways in close proximity to the intersection interfere with traffic operations and safety.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-23 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-7-A

Alternative 1-7-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-7-B

Alternative 1-7-B considered widening the Everett Street eastbound approach. However, field observations indicated that a two lane approach currently extends to Route 1A. No further modifications measurably improved operations and therefore this alternative was discarded from further consideration.

Alternative 1-7-C

Alternative 1-7-C assessed the existing signal timings and tested modifications to cycle length and phase lengths. It was determined that signal changes would not result in measureable operational improvements. Modifications to the signal operations at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-7-D

Alternative 1-7-D assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-7-E

Alternative 1-7-E considered constructing a jughandle to accommodate Route 1 southbound turning movements using the existing Glacier Drive/access road alignment. For safety and operational reasons, the jughandle would be designed as one-way southbound and Glacier Drive east of the jughandle would be one-way westbound. However, Glacier Drive is the only access point to several private developments. The alternative was therefore discarded from further consideration.

Alternative 1-7-F

Alternative 1-7-F would reconfigure and grade separate the intersection by constructing a Single Point Urban Interchange (with Everett Street/University Avenue over Route 1). On- and off-ramps would be constructed to provide access between Route 1 and Everett Street/University Avenue. Alternative 1-7-F also looked at grade separation with Everett Street/University Avenue under Route 1 but this design was not possible because of the existing infrastructure under Route 1. The existing signal would be removed and all Everett Street/University Avenue and Route 1 ramp movements would be accommodated on the Single Point Urban Interchange. Route 1 through traffic would be unimpeded under this alternative. This alternative would address all issues, A through D, identified previously.

Alternative 1-7-G

Alternative 1-7-G would grade separate the intersection by putting Route 1 on a structure in a diamond-type layout. On- and off-ramps would be constructed to provide access between Route 1 and Everett Street/University Avenue. The existing signal would be removed and replaced with two signals to accommodate all Everett Street/University Avenue and Route 1 ramp movements. This alternative would address all issues (A through D) described previously. A concept plan has been developed for Alternative 1-7-G and is included in the Appendix.

Alternative 1-7-H

Alternative 1-7-H would grade separate the intersection by putting Route 1 in a tunnel. On- and off-ramps would be constructed to provide access between Route 1 and Everett Street/University Avenue. The existing signal would be removed and replaced with two signals to accommodate all Everett Street/University Avenue and Route 1 ramp movements. This alternative would address all issues (A through D) described previously. A concept plan has been developed for Alternative 1-7-H and is included in the Appendix.

Alternative 1-7-I

Alternative 1-7-I would partially grade separate the intersection by putting Route 1 northbound traffic on a structure, while Route 1 southbound would still meet Everett at grade. On- and off-ramps would be constructed to provide access between Route 1 northbound and Everett Street/University Avenue. The existing signal would be modified and an additional signal would be installed to accommodate the Route 1 northbound ramp movements. This alternative would address issues A, B, and C described previously. The alternative would limit the impact toexiting driveways on the rest side of Route 1. A concept plan has been developed for Alternative 1-7-I and is included in the Appendix.

Alternative 1-7-J

Alternative 1-7-J would construct dual Route 1 northbound and southbound left-turn lanes. The additional left-turn lanes would be created out of the median and would each consist of 250 feet of storage length. In the AM and PM conditions, the signal cycle length would be optimized to allow the double left-turn lanes to operate more efficiently. However, the northbound and southbound left turn lanes continue to operate at LOS F in the morning and evening condition.

Table 4-23 Route 1 at Everett Street/University Avenue Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-7-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	○	○	○	○	○	○	N/A	○	No	Refer to Appendix for Alternative 1-7-A detailed notes
1-7-B	Extend 2 lane Everett Street EB approach	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-7-B detailed notes
1-7-C	Optimize existing signal timings/phasings	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-7-C detailed notes
1-7-D	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-7-D detailed notes
1-7-E	Construct Route 1 SB jughandle	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-7-E detailed notes
1-7-F	Construct SPUI interchange	✓	○	○	✖	○	✖	N/A	○	No	Potential moderate property takings and negative visual impacts. Refer to Appendix for Alternative 1-7-F detailed notes
1-7-G	Grade separate intersection and construct Route 1 NB and SB on-/off-ramps from Everett Street /University Avenue (Route 1 on structure)	✓	○	○	✖	○	✖	N/A	○	No	Potential moderate property takings and negative visual impacts. Refer to Appendix for Alternative 1-7-G detailed notes
1-7-H	Grade separate intersection and construct Route 1 NB and SB on-/off-ramps from Everett Street /University Avenue (Route 1 in tunnel)	✓	○	○	✖	○	✖	N/A	○	No	Potential moderate property takings and negative visual impacts. Refer to Appendix for Alternative 1-7-H detailed notes
1-7-I	Grade separate Route 1 NB only and construct Route 1 NB on-/off-ramps from Everett Street /University Avenue (Route 1 NB on structure)	○	○	○	✖	○	✖	N/A	✓	No	Potential moderate property takings, negative visual impacts, and traffic operation issues. Refer to Appendix for Alternative 1-7-I detailed notes
1-7-J	Construct dual Route 1 NB and SB left-turn lanes	○	○	○	✖	○	○	N/A	✓	Yes	Moderate traffic operations issues. Refer to Appendix for Alternative 1-7-J detailed notes

✓ Positive Impact
○ Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.8 Providence Highway at Elm Street

Several geometric, safety, and operational issues have been identified at the intersection of Providence Highway at Elm Street. These issues include:

A. During the AM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

B. During the PM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

C. During the AM, the Elm Street westbound and Route 1 northbound approaches have movements that operate at LOS E/F under existing and future conditions.

D. During the PM, the Elm Street westbound, Route 1 northbound, and Route 1 southbound approaches have movements that operate at LOS E/F under existing and future conditions.

E. During the PM, the Elm Street eastbound approach has movements that degrade to LOS E under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-24 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-8-A

Alternative 1-8-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-8-B

Alternative 1-8-B would close the right-in/ right-out hotel driveway along Route 1 southbound just south of intersection. This alternative would reduce vehicle conflicts and potentially improve safety along Route 1 southbound. The privately owned parcels and Ariadine Road could still be accessed via Route 1A and Elm Street.

Alternative 1-8-C

Alternative 1-8-C considered improving pedestrian accommodations at the intersection. However, new pedestrian signal equipment, crosswalks, and sidewalks are under construction as part of a private development. Therefore no modifications are proposed at this location and the alternative was discarded.

Alternative 1-8-D

Alternative 1-8-D would optimize the existing signal timings (cycle length and phase lengths) under the AM condition only. No modifications significantly improved operations under the PM condition and therefore nothing proposed is proposed. No changes to phase structure are proposed as part of this alternative. No geometric changes proposed as part of this alternative; alternative could be combined with others that would implement geometric improvements.

Alternative 1-8-E

Alternative 1-8-E would change the lane use on the Elm Street eastbound and westbound approaches. Elm Street eastbound would be changed from two left-turn lanes, a through lane, and a right-turn lane to a left-turn lane, through lane, and two right-turn lanes. Elm Street westbound would be changed from a left-turn lane, shared left-turn/through lane, and right-turn lane to two left-turn lanes and a shared through/right-turn lane. No lane use modifications are proposed to Route 1 northbound or southbound. With lane use changes, overlapping right-turns which conflict with Route 1 u-turn movements would be removed from the eastbound and westbound approaches.

Alternative 1-8-F

Alternative 1-8-F would construct dual Route 1 northbound and southbound left-turn lanes. A concept plan has been developed for Alternative 1-8-F and is included in the Appendix.

Table 4-24 Route 1 at Elm Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals?								Can Alternative can be combined with other Alternatives?	Notes
		Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs		
1-8-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-8-A detailed notes
1-8-B	Close right-in/ right-out driveway along Route 1 SB just south of intersection	O	✓	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 1-8-B detailed notes
1-8-C	Improve pedestrian accommodations	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-8-C detailed notes
1-8-D	Optimize existing signal timings/phasings	✓	O	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-8-D detailed notes
1-8-E	Assess lane usage efficiency	✓	✓	O	✖	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-8-E detailed notes
1-8-F	Construct dual Route 1 NB and SB left-turn lanes	✓	O	O	✖	O	O	N/A	✓	Yes	Refer to Appendix for Alternative 1-8-F detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.9 Providence Highway at Eastern Avenue

Several geometric, safety, and operational issues have been identified at the intersection of Providence Highway at Eastern Avenue. These issues include:

A. During the AM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

B. During the PM, the intersection operates at LOS F with greater than 120 seconds of delay under existing and future conditions.

C. During the AM, the Route 1 northbound and southbound approaches have movements that operate at LOS F under existing and future conditions.

D. During the PM, the Route 1 northbound and southbound approaches have movements that operate at LOS F under existing and future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-25 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-9-A

Alternative 1-9-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-9-B

Alternative 1-9-B considered improving pedestrian accommodations at the intersection. However, new pedestrian signal equipment, crosswalks, and sidewalks are under construction as part of an intersection improvement project. Therefore no modifications are proposed at this location and the alternative was discarded.

Alternative 1-9-C

Alternative 1-9-C would optimize the existing signal timings (cycle length and phase lengths) under the PM condition only. No modifications significantly improved operations under the AM condition and therefore nothing proposed is proposed. No changes to phase structure are proposed as part of this alternative. No geometric changes proposed as part of this alternative.

Alternative 1-9-D

Alternative 1-9-D assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Table 4-25 Route 1 at Eastern Avenue Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-9-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-9-A detailed notes
1-9-B	Improve pedestrian accommodations	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-9-B detailed notes
1-9-C	Optimize existing signal timings/phasings	✓	O	O	O	O	O	N/A	O	Yes	Refer to Appendix for Alternative 1-9-C detailed notes
1-9-D	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-9-D detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

4.5.10 Providence Highway at Washington Street

Several geometric, safety, and operational issues have been identified at the intersection of Providence Highway at Washington Street. These issues include:

A. The intersection crash rate (1.34) exceeds MassDOT average crash rate (0.88).

B. During the AM, the Washington Street eastbound approach has movements that operate at LOS E under existing and future conditions.

C. During the PM, the rotary south-eastbound approach has movements that operate at LOS E under existing and LOS F under future conditions.

D. During the PM, the Washington Street eastbound and Route 1 northbound approaches have movements that degrade to LOS E under future conditions.

The following potential short-term and long-term alternatives have been developed to address these deficiencies. The benefits and impacts/issues associated with each alternative were evaluated. Table 4-26 summarizes how each alternative addresses the project goals and objectives. A more detailed analysis outlining the benefits, issues, and cost estimates for each alternative is presented in the Appendix.

Alternative 1-10-A

Alternative 1-10-A would maintain the baseline conditions. This can also be described as the No-Build or Do-Nothing Alternative. This option does not propose any improvements to the 2030 Baseline Condition.

Alternative 1-10-B

Alternative 1-10-B would optimize the existing signal timings (cycle length and phase lengths). No changes to phase structure are proposed as part of this alternative. No geometric changes proposed as part of this alternative; alternative could be combined with others that would implement geometric improvements. This alternative addresses issues B, C, and D identified previously.

Alternative 1-10-C

Alternative 1-10-C assessed lane usage efficiency at the intersection. It was determined that lane use changes would not result in measureable operational improvements. Modifications to the lane usage at this location are not recommended and the alternative was therefore discarded from further consideration.

Alternative 1-10-D

Alternative 1-10-D would create one signalized intersection to accommodate all movements between Providence Highway and Washington Street. The rotary and two existing signals would be removed. This alternative addresses issues A, B, C, and D identified previously. A concept plan has been developed for Alternative 1-8-F and is included in the Appendix.

Alternative 1-10-E

Alternative 1-10-E would grade separate the intersection by putting Route 1 on a structure. On- and off-ramps would be constructed to provide access between Route 1 and Washington Street. The rotary and two existing signals would remain to accommodate all Washington Street and Providence Highway ramp movements. This alternative would address issues B, C, and D described previously.

Alternative 1-10-F

Alternative 1-10-F would reconfigure and grade separate the intersection by constructing a Single Point Urban Interchange. On- and off-ramps would be constructed to provide access between Route 1 and Washington Street. The rotary and two existing signals would remain to accommodate all Washington Street and Providence Highway ramp movements. This alternative would address issues B, C, and D described previously.

Table 4-26 Route 1 at Washington Street Alternatives Evaluation Summary

Alternatives		How does the Alternative address the Project Goals? Improve traffic flow on freeways, ramps and local streets in the study area	Improve safety for all modes of transportation within the study area	Improve mobility and transportation choice	Meet transportation goals while minimizing impacts to the quality of life for area communities	Protect and enhance the natural and cultural environment	Develop recommendations that can be implemented efficiently	The study will continue to be conducted through an open and inclusive process	Recommendations should address demonstrated needs	Can Alternative can be combined with other Alternatives?	Notes
1-10-A	Maintain Baseline Conditions (No-Build/Do-Nothing)	O	O	O	O	O	O	N/A	O	No	Refer to Appendix for Alternative 1-10-A detailed notes
1-10-B	Optimize existing signal timings/phasings	✓	O	O	O	O	✓	N/A	✓	Yes	Refer to Appendix for Alternative 1-10-B detailed notes
1-10-C	Assess lane usage efficiency	*Alternative Discarded*								N/A	Refer to Appendix for Alternative 1-10-C detailed notes
1-10-D	Eliminate rotary; create on signalized intersection	✓	✓	✓	✓	O	O	N/A	✓	No	Refer to Appendix for Alternative 1-10-D detailed notes
1-10-E	Grade separate intersection and construct Route 1 NB and SB on-/off-ramps from Washington Street (Route 1 on structure)	✓	O	O	O	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-10-E detailed notes
1-10-F	Construct SPUI interchange	✓	O	O	O	O	✖	N/A	O	No	Refer to Appendix for Alternative 1-10-F detailed notes

✓ Positive Impact
O Neutral Impact
✖ Negative Impact
n/a not applicable

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5

Recommendations

Based on the screening analysis as presented in Chapter 4, the project team categorized the study area improvements into a series of recommendations. Recommended improvements are those that best address the deficiencies within the study area, satisfy the evaluation criteria, and seek to minimize the environmental impacts of their implementation.

The recommendations include varying approaches to addressing several of the existing and future transportation needs identified. Each recommendation has been prioritized as a short-, medium-, or long-term action item for implementation.

This chapter discusses the recommended alternatives for the corridor, interchanges, and local intersections.

5.1 Recommendation Selection Methodology

A range of alternatives was developed through the study process as described in Chapter 4. Each alternative was evaluated to determine how effectively it addressed the goals and objectives of the study. The alternatives that appeared to offer the most potential after completion of the analysis and evaluation were then reviewed with MassDOT, the Working Group, Study Advisory Group, community representatives, and the general public. Following those outreach meetings, a series of specific actions and improvements were developed into recommended short-, medium-, and long-term alternatives for each location.

The strategies and actions were divided into three classifications: short-term actions, medium-term actions, and long-term actions. Additionally, the various options also note that:

Short-term alternatives are generally easy to implement, could be constructed in the 0-5 year time frame, generally have no right-of-way impacts, are relatively low-cost, and have little to no environmental permitting or impact on area constraints.

Medium-term alternatives are more complex to implement, could be constructed in the 5-10 year time frame, have minor right-of-way impacts, are more costly, and would likely require environmental permitting and impact on area constraints that would need to go through a longer period of design and permitting before implementation could be realized.

Long-term alternatives are highly complex to implement, would be constructed in the 10-20 year time frame, likely have right-of-way impacts, would require significant capital cost, and would require high levels of environmental permitting with significant impacts to area constraints that would likely require a very detailed design and permitting process to implement.

The results of effort include a short-, medium-, and long-term alternative recommendation plan for each location within the study area. This recommendation plan is presented below.

5.2 Short-Term Recommendations

Short-term recommendations include those actions that address existing safety and operational deficiencies to the transportation infrastructure within the study area. For the most part, these improvements include low-cost options that can be implemented in a short time-frame (0-5 years), with minimal efforts, and limited to no environmental impact. The short-term recommendations are as follows:

TDM/TSM Actions

- Study and begin implementation of recommended travel demand management (TDM) and transportation system management (TSM) actions:
- Begin implementation of recommended geometric improvements to the I-95 mainline corridor where opportunities present themselves (as maintenance projects are conducted);
- Encourage communities to review and develop appropriate zoning needs in and around areas where medium- and/or long-term transportation investment is being considered;
- Address gaps in the Route 1 sidewalk network along the entire corridor where appropriate;
- Work with transit providers to explore and implement local and regional transit connections including connection between the different RTAs;
- Continue to explore feasibility of increasing commuter rail frequency – particularly along Attleboro and Franklin corridors;
- Evaluate access and parking issues at stations along the Commuter Rail corridors, specifically at Mansfield and Attleboro;

- Consider the impacts of the South Coast Rail evaluation along the I-95 and Route 1 corridors. Seek opportunities to enhance transit connections within the I-95 south study area as a result of the final outcome of the South Coast Rail effort;
- Conduct planning study of upgrading Foxborough (Gillette Stadium) to full-time Commuter Rail station (currently underway by MBTA); and
- Develop and deploy elements of Intelligent Transportation Systems (ITS) along the I-95 and Route 1 corridors (dynamic message signs, microwave vehicle detection systems, closed-circuit television cameras, and expansion of the Traffic Operations Center to include areas of the I-95 corridor) to allow better use of the existing system and take advantage of the multiple alternate routes accessible along I-95.

I-95 Corridor Actions

<u>I-95 (Exit 2) *(Conceptual Cost Estimate = $803,000)*</u>

- Extend I-95 acceleration lanes to meet current design standards;
- Consolidate gas-station driveways along Route 1A between I-95 northbound off-ramp and MBTA driveway.
- Extend I-95 northbound deceleration lane off-ramp to Route 1A southbound; and
- Extend I-95 southbound acceleration lane on-ramp from Route 1A southbound.

<u>I-95 (Exit 3) *(Conceptual Cost Estimate = $825,000)*</u>

- Extend all acceleration lanes on I-95 to meet current design standards;
- Prohibit Lathrop Road southbound left-turns & widen Route 123 eastbound to accommodate left-turn lane to Lathrop Road; and
- Signalize intersection of route 123 at I-95 northbound off-ramps.

<u>I-95 (Exit 4) *(Conceptual Cost Estimate = $299,000)*</u>

- Extend deceleration lane along I-95 southbound off-ramp to I-295 southbound.

<u>I-95 (Exit 5) *(Conceptual Cost Estimate, excluding park and ride lot = $14,000)*</u>

- Address signage ordering along I-95 southbound; and
- Install advance warning signage for "signal ahead" at end of I-95 northbound off-ramp.
- Consider development of park and ride lot.

<u>I-95 (Exit 6) *(Conceptual Cost Estimate = $375,000)*</u>

- Extend I-95 southbound off-ramp deceleration lane to I-495 northbound; and
- Extend I-495 southbound off-ramp deceleration lane to I-95 southbound.

<u>I-95 (Exit 7) *(Conceptual Cost Estimate = $1,913,000):*</u>

- Extend I-95 northbound off-ramp deceleration lane to Route 140 southbound;
- Extend I-95 southbound off-ramp deceleration lane to Route 140 northbound;
- Extend I-95 northbound on-ramp acceleration lane from Route 140 northbound; and
- Extend I-95 southbound on-ramp acceleration lane from Route 140 southbound.

<u>I-95 (Exit 8) *(Conceptual Cost Estimate = $11,840,000)*</u>

- Review proposed signal timings/phasings at of South Main Street and I-95 northbound ramps as initially presented in the Sharon Commons traffic impact study;
- Extend I-95 northbound off-ramp deceleration lane;
- Extend I-95 northbound on-ramp acceleration lane;
- Extend I-95 southbound off-ramp deceleration lane; and
- Extend I-95 southbound on-ramp acceleration lane.
- I-95 (Exit 9) *(Conceptual Cost Estimate, excluding park and ride lot = $955,000)*:
- Extend I-95 southbound off-ramp deceleration lane; and
- Extend I-95 southbound on-ramp acceleration lane.
- Consider development of park and ride lot.

<u>I-95 (Exit 10) *(Conceptual Cost Estimate = $210,000)*</u>

- Monitor and signalize intersection of Coney Street at I-95 southbound off-ramp when signal warrants are met.

<u>I-95 (Exit 11) *(Conceptual Cost Estimate = $474,000)*</u>

- Optimize signal timings at Wedgewood Drive/Neponset Street intersection;
- Investigate signal coordination between signals along Neponset Street (Cherrywood Drive & Wedgewood Drive); and
- Extend I-95 northbound on-ramp from Neponset Street eastbound & westbound.
- I-95 (Future Exit 12 – Dedham Street)
- Continue to advance I-95 northbound off-ramp to Dedham Street.

I-495 Corridor Actions

<u>I-495 (Exit 11) *(Conceptual Cost Estimate = $68,000)*</u>

- Formalize Route 140 northbound U-turn movement at School Street intersection.

<u>I-495 (Exit 14) *(Conceptual Cost Estimate = $2,729,000)*</u>

- Widen Route 1 northbound under I-95 to provide three fully striped lanes;
- Extend I-495 northbound on-ramp acceleration lane from Route 1 southbound; and
- Extend I-495 southbound off-ramp deceleration lane to Route 1 southbound.

I-495 (Exit 15) (Conceptual Cost Estimate = $268,000)

- Work with the town to create a public-private working group to consider long-term solutions to transportation issues along Route 1A; and
- Extend I-495 northbound off-ramp deceleration lane to Route 1A.

Route 1 Actions

Route 1 and Route 123(*Conceptual Cost Estimate = $14,000)*

- Prohibit Route 1 southbound left-turn movement at Route 123;
- Optimize signal timings and phasings; and
- Implement access management strategies for immediate area and for future developments.

Route 1 and Route 1A/Elmwood Street

- No short-term recommendations.

Route 1 and East Street / Main Street *(Conceptual Cost Estimate = $604,000)*

- Extend Route 1 median through intersection;
- Improve directional signage;
- Extend Route 1 acceleration and deceleration lanes in both directions;
- Redesignate Pine Street (between Route 1 and Turner Road) as Route 115; and
- Implement access management strategies for immediate area and for future developments.

Route 1 and Route 27 / High Plan Street *(Conceptual Cost Estimate = $122,000)*

- Install LED/ advance warning signs for signal ahead along Route 1 northbound and southbound;
- Implement access management strategies;
- Restrict right turns on red for Route 27 eastbound approach;
- Widen Route 27 westbound approach; and
- Paint/score concrete Route 1 truck u-turn areas to more clearly define Route 1 through lanes.

Route 1 and Coney Street *(Conceptual Cost Estimate = $28,000)*

- Install LED/ advance warning signs for signal ahead along Route 1 northbound;
- Paint/score concrete Route 1 northbound truck u-turn area to more clearly define Route 1 southbound through lanes;
- Improve pedestrian accommodations; and
- Optimize existing signal timings/phasings.

Route 1 and Dean Street *(Conceptual Cost Estimate = $14,000)*

- Improve lane markings/signage at three intersections; and
- Assess Staples plaza access.

Route 1 and Everett Street / University Avenue

- No short term recommendations.

Providence Highway and Elm Street *(Conceptual Cost Estimate = $15,000)*

- Close the right-in/ right-out hotel driveway along Route 1 southbound just south of intersection.

Providence Highway and Eastern Avenue

- No short-term recommendations.

Providence Highway and Washington Street *(Conceptual Cost Estimate = $7,000)*:

- Optimize existing signal timings/phasings on an on-going basis.

5.3 Medium-Term Recommendations

Medium-term recommendations include improvements that focus on the near-term future transportation needs, have longer permitting and design efforts, and can be more costly than the previously presented short-term actions. It is anticipated that these would be carried forward in a 5-10 year timeframe. The medium-term recommendations are as follows:

I-95 Corridor Actions

I-95 (Exit 1) *(Conceptual Cost Estimate = $4,429,000)*

- Extend I-95 southbound off-ramp deceleration lane;
- Construct median along Route 1 to prevent turning traffic;
- Restrict Scott Street to right-in/right-out operations; and
- Construct Route 1 southbound left-turn lane to I-95 northbound on-ramp.

I-95 (Exit 3) *(Conceptual Cost Estimate = $1,021,000)*

- Realign Lathrop Road with I-95 northbound ramps;
- Cul-de-sac existing Lathrop Road;
- Remove I-95 northbound on-ramp from Route 123 eastbound; and
- Modify signal proposed as short-term alternative to accommodate realigned intersection.

I-95 (Exit 4) *(Conceptual Cost Estimate = $7,059,000)*

- Construct new two lane, high-speed I-95 southbound to I-295 southbound ramp connection with new diverging lanes from I-95 southbound; eliminate existing ramp; and
- Realign I-295 northbound to I-95 southbound ramp to flatten curve.

I-95 (Exit 5) *(Conceptual Cost Estimate = $11,077,000)*

- Extend I-95 northbound off-ramp deceleration lane;
- Extend I-95 northbound on-ramp acceleration lane; and
- Extend I-95 southbound on-ramp acceleration lane

I-95 (Exit 6) *(Conceptual Cost Estimate = $58,607,000)*

- Realign the following ramps to flatten curves:
  - I-95 northbound to I-495 southbound;
  - I-495 northbound to I-95 northbound;
  - I-95 southbound to I-495 northbound; and
  - I-495 southbound to I-95 southbound.

Route 1 Actions

Route 1 & Route 1A/Elmwood Street (*Conceptual Cost Estimate = $210,000)*

- Signalize intersection of Route 1A at Elmwood Street and coordinate with Route 1 at Route 1A/Elmwood Street signal.
  Route 1 & Everett Street / University Avenue *(Conceptual Cost Estimate = $1,710,000)*:
- Construct dual Route 1 northbound and southbound left-turn lanes.

Providence Highway and Elm Street *(Conceptual Cost Estimate = $781,000)*

- Construct dual Route 1 northbound and southbound left-turn lanes.

Providence Highway and Washington Street *(Conceptual Cost Estimate = $880,000)*

- Eliminate rotary and two signalized intersections and replace with single signalized intersection.

5.4 Long-Term Recommendations

Long-term recommendations are capital intensive and often take longer periods of time to design, fund, and construct. It is anticipated that these projects would be carried forward in the 10-20 year timeframe. They include those actions that may not be necessary under existing conditions, but will be needed to handle future roadway and interchange demands if the trends highlighted in this report remain accurate. The long term recommendations are as follows:

TDM/TSM Actions

- Study and begin implementation of recommended travel demand management (TDM) and transportation system management (TSM) actions:
- Develop and deploy either a new traffic control center or expand the current traffic control center to assist in the integration of the Intelligent Transportation Systems (ITS) components along the I-95 and Route 1 corridors.

I-95 Mainline Widening

Monitor and implement widening of the I-95 mainline corridor as needed along three separate and distinct segments. These segment progress from north to south and generally decrease in priority (although traffic monitoring and implementation of several prior recommendations may eliminate the need to widen and/or the order in which these segments are widened):

- Exit 12 (I-93/Route 128) to Exit 9 (Route 1)
- Exit 9 (Route 1) to Exit 6 (I-495)
- Exit 6 (I-495) to Exit 4 (I-295)

It is recommended that a single general purpose lane be added only in each direction – although consideration of transit options should be re-evaluated at some point in the future to determine if a more robust infrastructure is in place to justify transit or HOV lanes along the corridor.

I-95 Corridor Actions

I-95 (Exit 1) *(Conceptual Cost Estimate = $154,000)*

- Consider elimination of this interchange if safety issues continue along I-95 mainline.

I-95 (Exit 2) *(Conceptual Cost Estimate = $1,561,000)*

- Construct partial cloverleaf design for both northbound and southbound I-95 corridors removing the northeast and southwest loop ramps; and
- Signalize ramp connections along Route 1A where appropriate.

I-95 (Exit 3) *(Conceptual Cost Estimate = $1,218,000)*

- Remove I-95 southbound off-ramp to Route 123 eastbound and accommodate movement at opposite I-95 southbound off-ramp;
- Construct I-95 southbound on-ramp from Route 123 eastbound; and
- Signalize intersection and coordinate with signal installed as part of short-term alternative at I-95 northbound/Lathrop Road intersection.

I-95 (Exit 4) *(Conceptual Cost Estimate = $54,502,000)*

- Construct 3-level ramp system to accommodate high-speed movements between I295 northbound and I-95 northbound.

I-95 (Exit 6) *(Conceptual Cost Estimate excluding longer-term considerations = $215,610,000)*

- Replace the following loop ramps with flyover, high-speed directional, and two lane ramps in the long-term:
  - I-95 northbound to I-495 northbound ; and
  - I-95 southbound to I-495 southbound
- Longer-term consideration should also be given to:
  - Construct flyover ramp from I-495 southbound to I-95 northbound; remove existing loop ramp; and
  - Construct flyover ramp from I-495 northbound to I-95 southbound; remove existing loop ramp.

I-95 (Exit 7) (Conceptual Cost Estimate = $3,048,000):

- Construct a partial cloverleaf ramp system by removing the loop ramps in southeast and northwest quadrants of interchange; and
- Install fully actuated traffic signal at the intersection of Route 140 and the relocated Walnut Street.

I-95 (Exit 9) *(Conceptual Cost Estimate = $11,831,000)*

- Construct recommendations identified in the Route 1 safety FEIR.

I-95 (Exit 10) (*Conceptual Cost Estimate = $10,612,000)*

- Complete diamond interchange by constructing a northbound off-ramp and a southbound on-ramp;
- Signalize intersections of new ramps with Coney Street; and
- Widen Coney Street to two lanes in each direction from interchange to Route 1.

I-95 (Exit 11) *(Conceptual Cost Estimate = $623,000)*

- Construct partial cloverleaf interchange by eliminating the I-95 northbound loop ramp accommodating the off-ramp movement.

I-495 Corridor Actions

I-495 (Exit 15)

- Monitor and develop long-term recommendations based on Town, Developer, and State working group.

Route 1 Actions

Route 1 and Coney Street: *(Conceptual Cost Estimate = $378,000)*

- Construct dual Route 1 southbound left-turn lanes (in concert with completion of I-95 Exit 10 interchange).

Route 1 and Everett Street / University Avenue *(Conceptual Cost Estimate = $5,028,000)*

- Grade separate Route 1 northbound;
- Construct Route 1 northbound on-/off-ramps from University Avenue; and
- Signalize intersection and coordinate with existing Route 1 signal.

The recommended alternatives described above are depicted graphically in Figures 5-1 though 5-36.

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Moving Massachusetts Forward. massDOT

0 65 130 Feet

Legend

WETLAND

DESIGN CRITERIA

ROUTE 1 - WASHINGTON STREET	
CLASSIFICATION	ARTERIAL
TRAVEL LANE WIDTH	11 FT
SHOULDER WIDTH	4 FT
DESIGN SPEED	40 MPH
MEDIAN TYPE	ISLAND
MEDIAN WIDTH	X FT MIN

I-95 SOUTH TO WASHINGTON STREET	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	4 FT
RAMP DESIGN SPEED	30 MPH
EXISTING DECEL LENGTH	500 FT
REQUIRED DECEL LENGTH	520 FT

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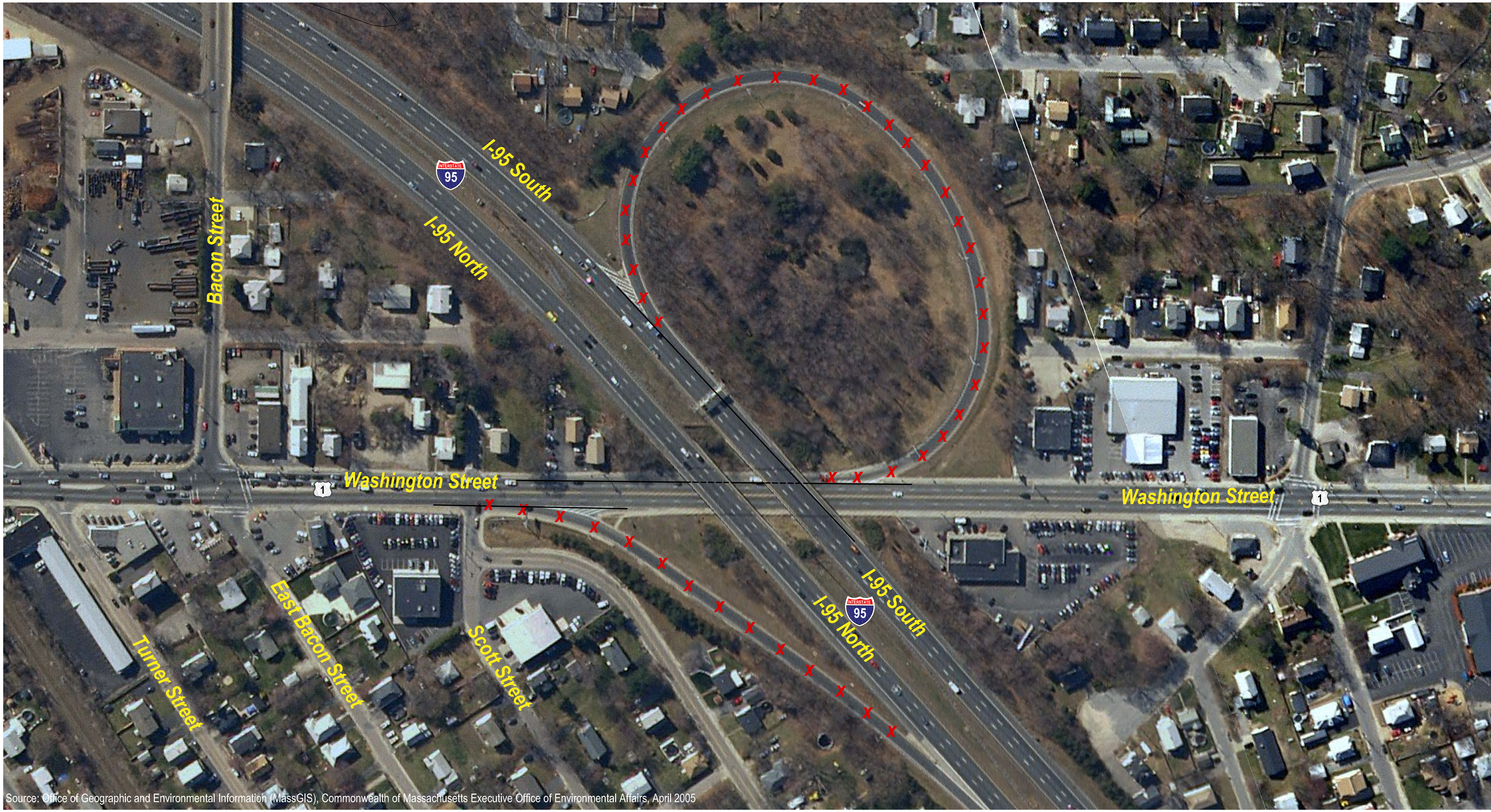
Figure 5.1

I-95 Exit 1 - Route 1
Medium-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 1 - LT.dwg



Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 80 160 Feet

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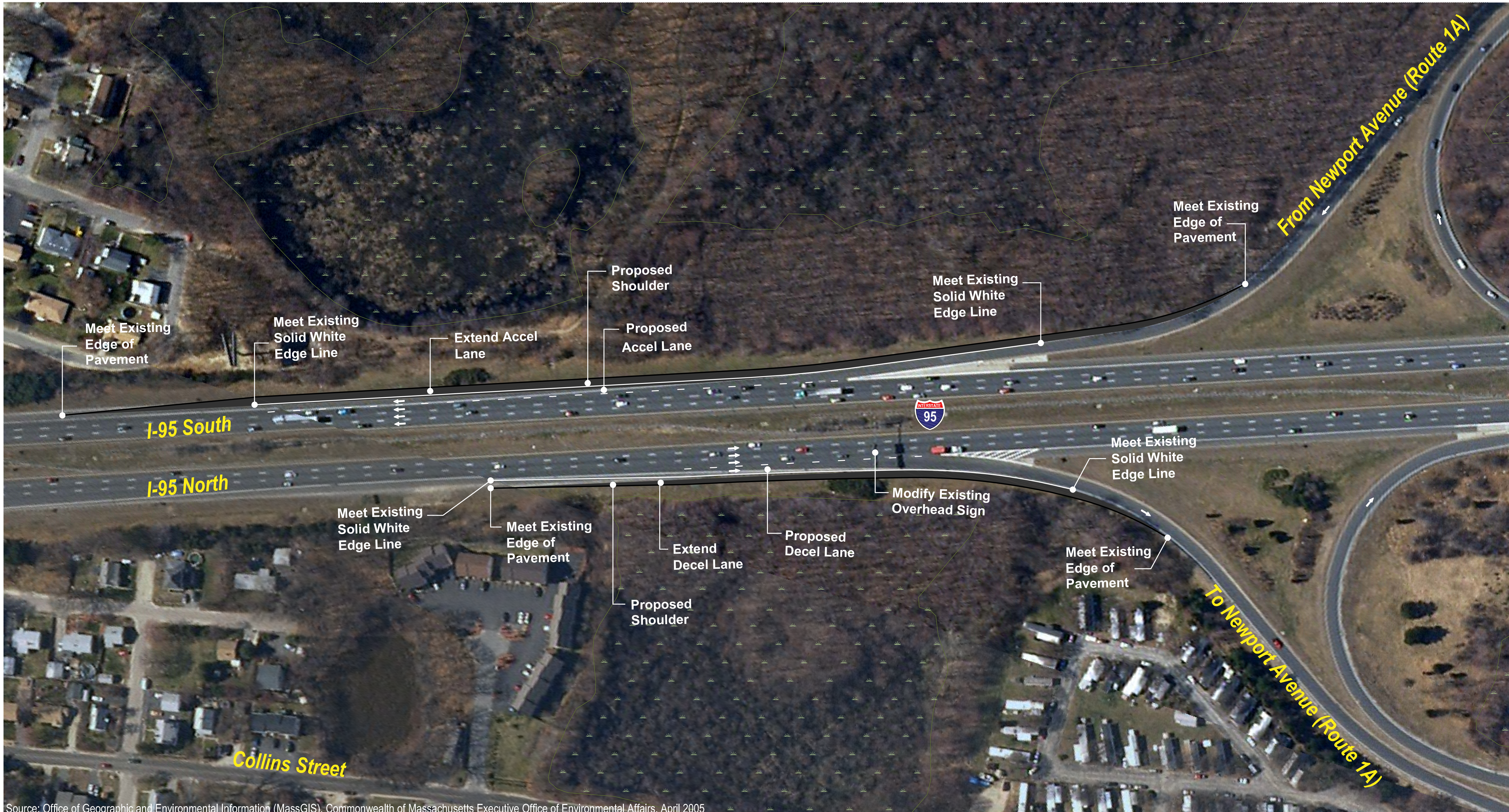
Figure 5.2

I-95 Exit 1 - Route 1
Long-Term Alternative



Moving Massachusetts Forward. massDOT

0 75 150 Feet

Legend

WETLAND

DESIGN CRITERIA

NEWPORT AVENUE SOUTH TO I-95 SOUTH	
ACCEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	35 MPH
EXISTING ACCEL LENGTH	925 FT
REQUIRED ACCEL LENGTH	1,230 FT

I-95 NORTH TO NEWPORT AVENUE SOUTH	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	35 MPH
EXISTING DECEL LENGTH	275 FT
REQUIRED DECEL L LENGTH	340 FT

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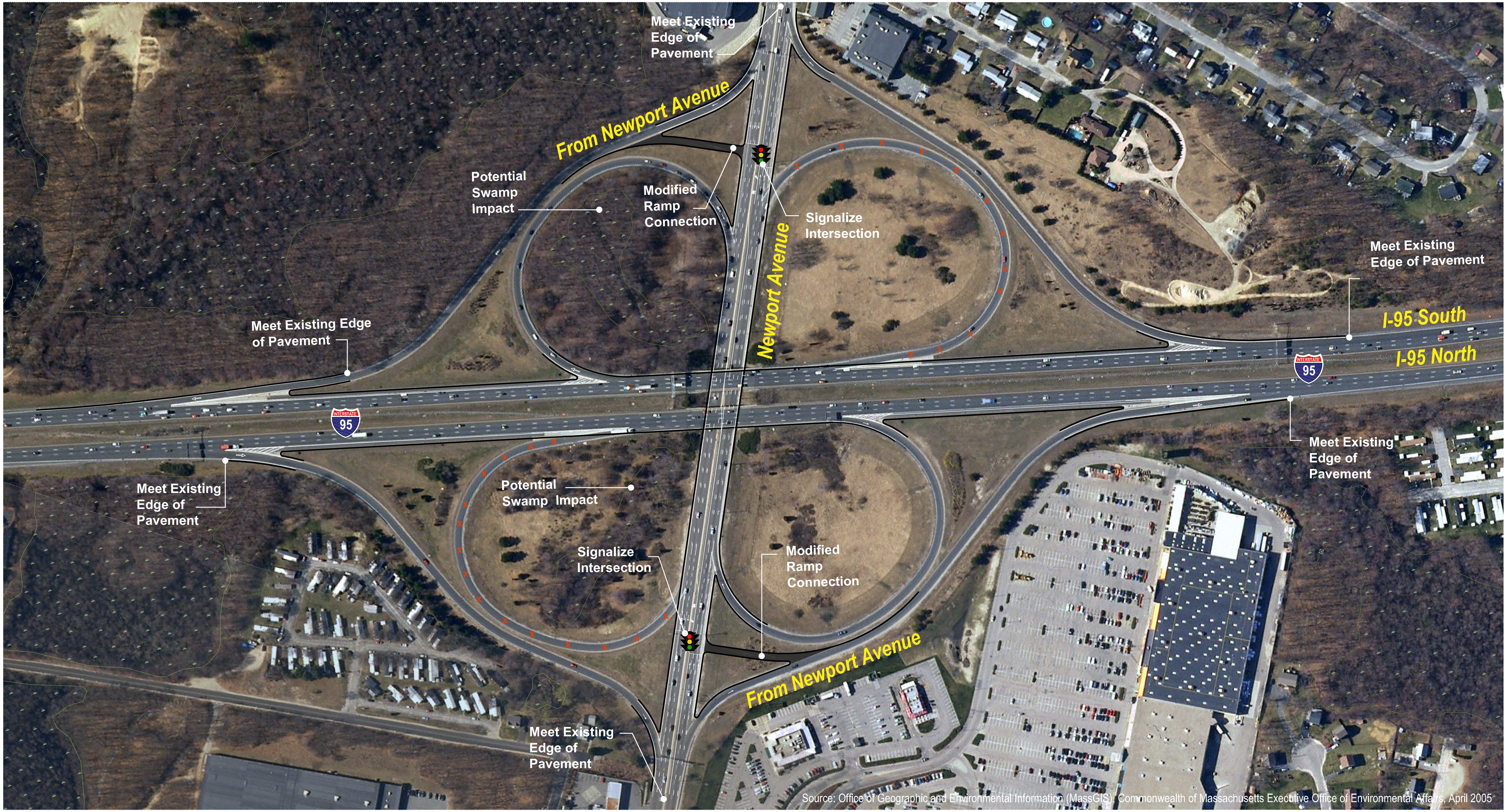
Figure 5.3

I-95 Exit 2 - Route 1A
Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 2 - Rt 1A - LT.dwg



Moving Massachusetts Forward. massDOT

0 125 250 Feet

Legend

WETLAND

DESIGN CRITERIA

PROPOSED RAMP DESIGN CRITERIA	
DESIGN SPEED	70 MPH
MINIMUM RAMP WIDTH	22 FT (SINGLE LANE RAMP)
GRADE	0.5% - 6%
MAXIMUM SUPERELEVATION	6%
REQUIRED ACCEL LENGTH	2,040 FT
VERTICAL CLEARANCE	16.5 FT

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Figure 5.4

I-95 Exit 2 - Route 1A
Long-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 3-Rt 123 - ST.dwg

Moving Massachusetts Forward. massDOT

0 75 150 Feet

Legend

WETLAND

DESIGN CRITERIA

ROUTE 123	
DESIGN SPEED	40 MPH
LANE WIDTH	11 FT
SHOULDER WIDTH	4 FT
LENGTH OF TURN LANE	125 FT
ROADWAY CLASSIFICATION	ARTERIAL

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Figure 5.5

I-95 Exit 3 - Route 123
Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 3-Rt 123 - MT.dwg

Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 50 100 Feet

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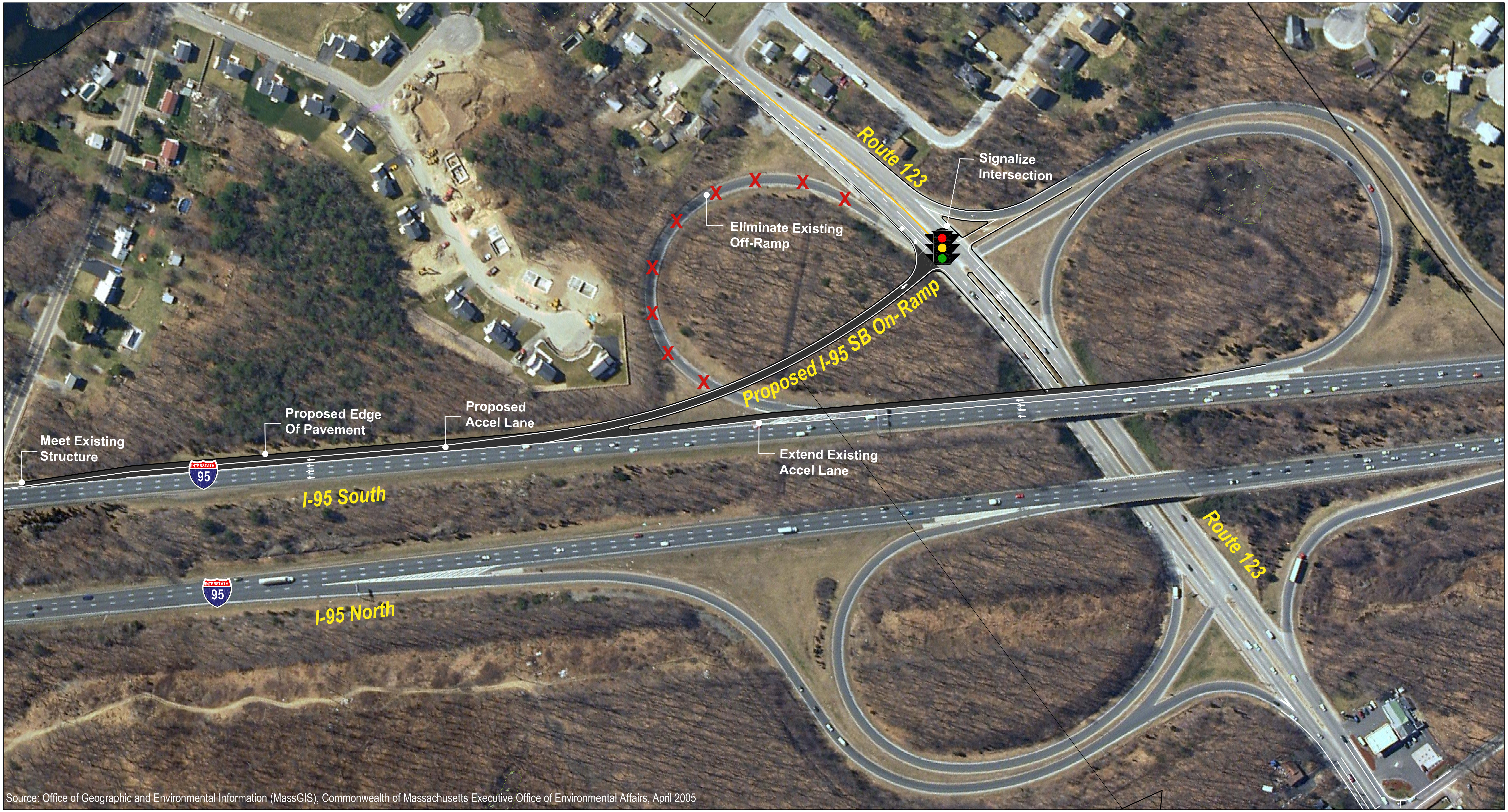
Figure 5.6

I-95 Exit 3 - Route 123
Medium-Term Alternative



Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 100 200 Feet

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Figure 5.7

I-95 Exit 3 - Route 123
Long-Term Alternative

Moving Massachusetts Forward. massDOT

0 75 150 Feet

Legend

WETLAND

DESIGN CRITERIA

I-95 SOUTH TO I-295 NORTH	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTING DECEL LENGTH	295 FT
REQUIRED DECEL LENGTH	340 FT

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Figure 5.8

I-95 Exit 4 - I-295
Short-Term Alternative

MAINLINE DESIGN CRITERIA	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
MAXIMUM GRADE	3%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT

RAMP DESIGN CRITERIA	
DESIGN SPEED	70 MPH
MINIMUM RAMP WIDTH	30 FT (DOUBLE LANE RAMP)
GRADE	0.5%-6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT
EXIT AUXILIARY LANE LENGTH	1,500 FT

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Figure 5.9

I-95 Exit 4 - I-295
Medium-Term Alternatives

\\Vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 4 - I-295 - LT.dwg

Moving Massachusetts Forward. massDOT

0 400 800 Feet

Legend

WETLAND

TOWN BOUNDARY

DESIGN CRITERIA

MAINLINE	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5FT

RAMP DESIGN	
DESIGN SPEED	70 MPH
MIN RAMP WIDTH (DOUBLE LANE)	30 FT
GRADE	0.5% - 6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT

RAMP DESIGN	
DOUBLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT
ENTRANCE AUXILIARY LANE TAPER LENGTH	840 FT
SINGLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT

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Figure 5.10

I-95 Exit 4 - I-295
Long-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 5-Toner Blvd- MT.dwg

Moving Massachusetts Forward massDOT

Legend

WETLAND

0 130 260 Feet

DESIGN CRITERIA

TONER BLVD TO I-95 SOUTH	
ACCEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTING ACCEL LENGTH	795 FT
REQUIRED ACCEL LENGTH	1,350 FT

I-95 NORTH TO TONER BLVD	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	25 MPH
EXISTING DECEL LENGTH	455 FT
REQUIRED DECEL LENGTH	520 FT

TONER BLVD TO I-95 NORTH	
ACCEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	35 MPH
EXISTING ACCEL LENGTH	850 FT
REQUIRED ACCEL LENGTH	1,230 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.11

I-95 Exit 5 - Toner Boulevard

Medium - Term Alternative

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 130 260 Feet

DESIGN CRITERIA

I-95 SOUTH TO I-495 NORTH	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	40 MPH
EXISTING DECELERATION LENGTH	370 FT
REQUIRED DECELERATION LENGTH	440 FT

I-495 SOUTH TO I-95 SOUTH	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTING DECELERATION LENGTH	490 FT
REQUIRED DECELERATION LENGTH	520 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.12

I-95 Exit 6 - I-495

Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 6 - I-495 MT.dwg

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward. massDOT

Legend

WETLAND

TOWN BOUNDARY

0 750 1500 Feet

DESIGN CRITERIA

MAINLINE DESIGN CRITERIA	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
MAXIMUM GRADE	3%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT

RAMP DESIGN CRITERIA	
MINIMUM DESIGN SPEED	35 MPH
MINIMUM RAMP WIDTH	30 FT (DOUBLE LANE
GRADE	0.5% - 6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	340 FT
VERTICAL CLEARANCE	16.5 FT
EXIT AUXILIARY LANE LENGTH	1,500 FT
DOUBLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT
ENTRANCE AUXILIARY LANE TAPER LENGTH	840 FT
SINGLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.13

I-95 Exit 6 - I-495
Medium-Term Alternative

Moving Massachusetts Forward. massDOT

Legend

WETLAND

TOWN BOUNDARY

0 1100 2200 Feet

DESIGN CRITERIA

MAINLINE DESIGN CRITERIA	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
MAXIMUM GRADE	3%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT

RAMP DESIGN CRITERIA	
DESIGN SPEED	70 MPH
MINIMUM RAMP WIDTH	30 FT (DOUBLE LANE
GRADE	0.5% - 6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5 FT
EXIT AUXILIARY LANE LENGTH	1,500 FT
DOUBLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT
ENTRANCE AUXILIARY LANE TAPER LENGTH	840 FT
SINGLE ENTRANCE AUXILIARY LANE LENGTH	1,680 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.14

I-95 South Exit 6 - I-495
Long-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-95 Exit 7-Rt 140 - ST.dwg

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward.
massDOT

Legend

WETLAND

0 150 300 Feet

DESIGN CRITERIA

ROUTE 140 SOUTH TO I-95 SOUTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG ACCELERATION LENGTH	450 FT
REQUIRED ACCELERATION LENGTH	1350 FT

I-95 NORTH TO ROUTE 140 SOUTH	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG DECEL LENGTH	450 FT
REQUIRED DECEL LENGTH	520 FT

I-95 SOUTH TO ROUTE 140 NB	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG DECEL LENGTH	450 FT
REQUIRED DECEL LENGTH	520 FT

ROUTE 140 NORTH TO I-95 NORTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG ACCELERATION LENGTH	725 FT
REQUIRED ACCELERATION LENGTH	1350 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.15

I-95 Exit 7 - Route 140
Short-Term Alternative

Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 200 400 Feet

DESIGN CRITERIA

MAINLINE	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
MAXIMUM GRADE	3%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.5FT

RAMP	
MINIMUM DESIGN SPEED	35 MPH
MINIMUM RAMP WIDTH (SINGLE LANE)	22 FT
MINIMUM RAMP WIDTH (DOUBLE LANE)	30 FT
GRADE	.5% - 6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	340 FT
VERTICAL CLEARANCE	16.5FT
ACCELERATION LANE LENGTH	1,230 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.16

I-95 Exit 7 - Route 140
Long-Term Alternative

Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 130 260 Feet

DESIGN CRITERIA

MECHANIC STREET TO I-95 SOUTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG ACCELERATION LENGTH	1125 FT
REQUIRED ACCELERATION LENGTH	1350 FT

I-95 NORTH TO SOUTH MAIN STREET	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG DECELERATION LENGTH	300 FT
REQUIRED DECELERATION LENGTH	520 FT

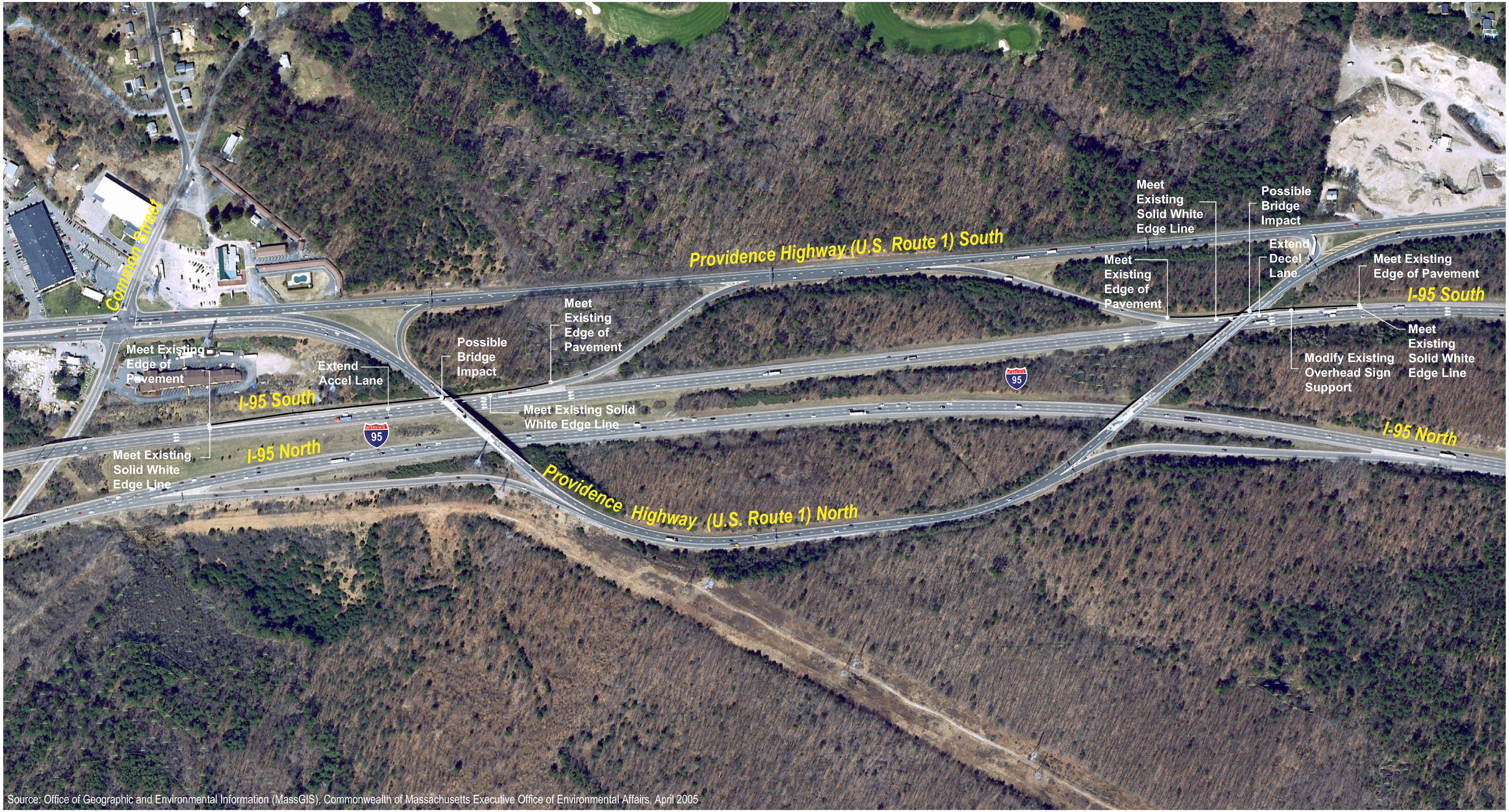
I-95 SOUTH TO MECHANIC STREET	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG DECELERATION LENGTH	280 FT
REQUIRED DECELERATION LENGTH	520 FT

SOUTH MAIN STREET TO I-95 NORTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	25 MPH
EXISTNG ACCELERATION LENGTH	950 FT
REQUIRED ACCELERATION LENGTH	1350 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.17

I-95 Exit 8 -Mechanic Street Short-Term Alternative



Moving Massachusetts Forward. massDOT

0 175 350 Feet

LEGEND

WETLAND

DESIGN CRITERIA

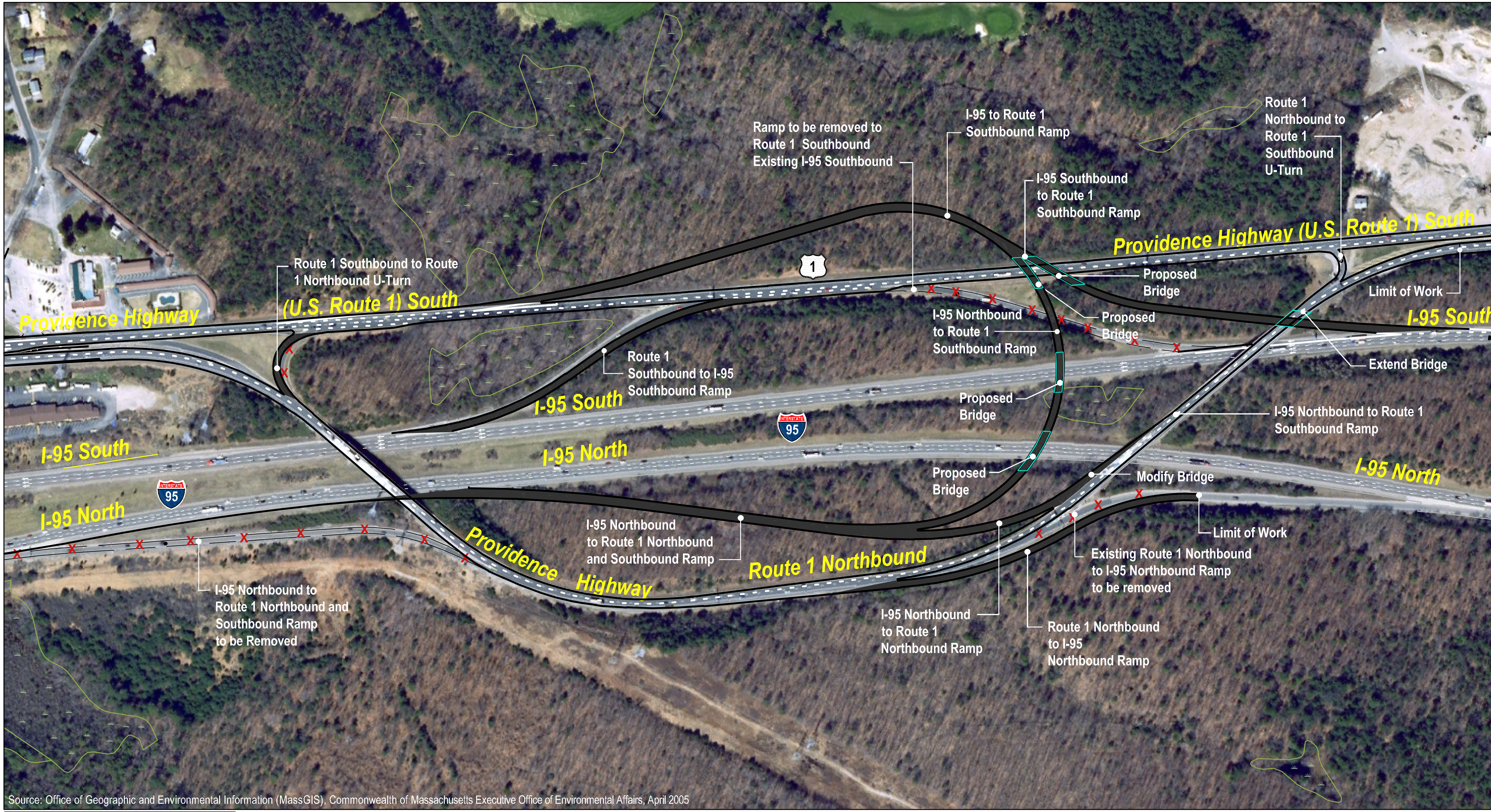
ROUTE 1 TO I-95 SOUTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	40 MPH
EXISTNG ACCELERATION LENGTH	400 FT
REQUIRED ACCELERATION LENGTH	1000 FT

I-95 SOUTH TO ROUTE 1	
DECEL LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	40 MPH
EXISTNG DECEL LENGTH	260 FT
REQUIRED DECEL LENGTH	340 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.18

I-95 Exit 9 - Route1
Short-Term Alternative



Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

massDOT
Moving Massachusetts Forward.

Legend

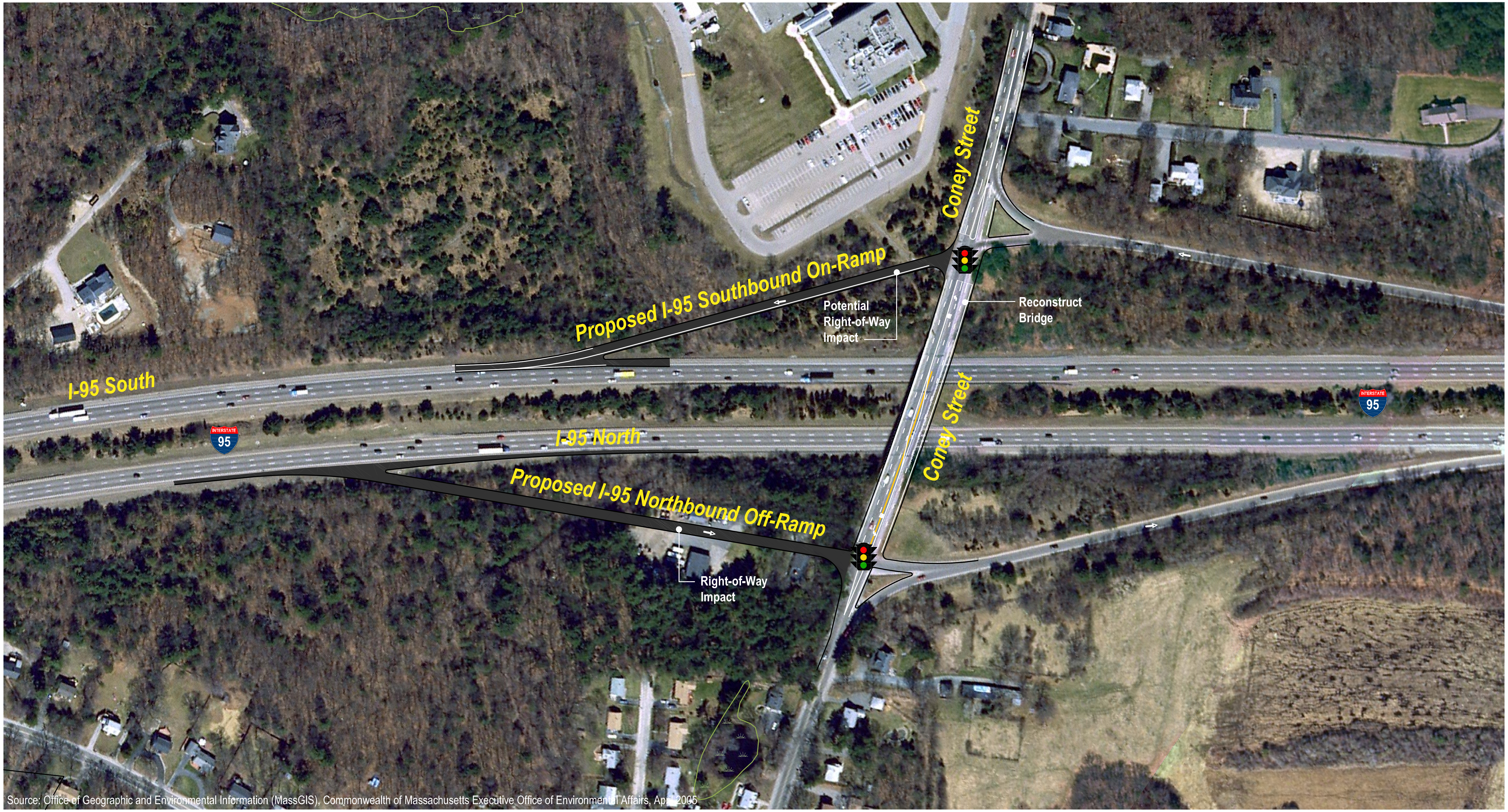
WETLAND

0 150 300 Feet

Vanasse Hangen Brustlin, Inc.

Figure 5.19

I-95 Exit 9 - Route 1
Long-Term Alternative



Moving Massachusetts Forward. massDOT

0 100 200 Feet

Legend

WETLAND

DESIGN CRITERIA

RAMP	
DESIGN SPEED	50 MPH
MINIMUM RAMP WIDTH	22 FT
GRADE	0.5% -0.6%
MAXIMUM CURVE RADIUS	1,000 FT
VERTICAL CLEARANCE	16.5 FT
DECELERATION LENGTH	340 FT
ACCELERATION LENGTH	580 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.20

I-95 Exit 10 - Coney Street
Long-Term Alternative

Moving Massachusetts Forward. massDOT

0 75 150 Feet

Legend

WETLAND

DESIGN CRITERIA

NEPONSET STREET SOUTH TO I-95S	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG ACCELERATION LENGTH	860 FT
REQUIRED ACCELERATION LENGTH	1350 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.21

I-95 Exit 11 - Neponset Street
Short-Term Alternative

Moving Massachusetts Forward. massDOT

0 150 300 Feet

Legend

WETLAND

TOWN BOUNDARY

DESIGN CRITERIA

MAINLINE	
DESIGN SPEED	70 MPH
LANE WIDTH	12 FT
MAXIMUM GRADE	3%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	2,040 FT
VERTICAL CLEARANCE	16.6 FT

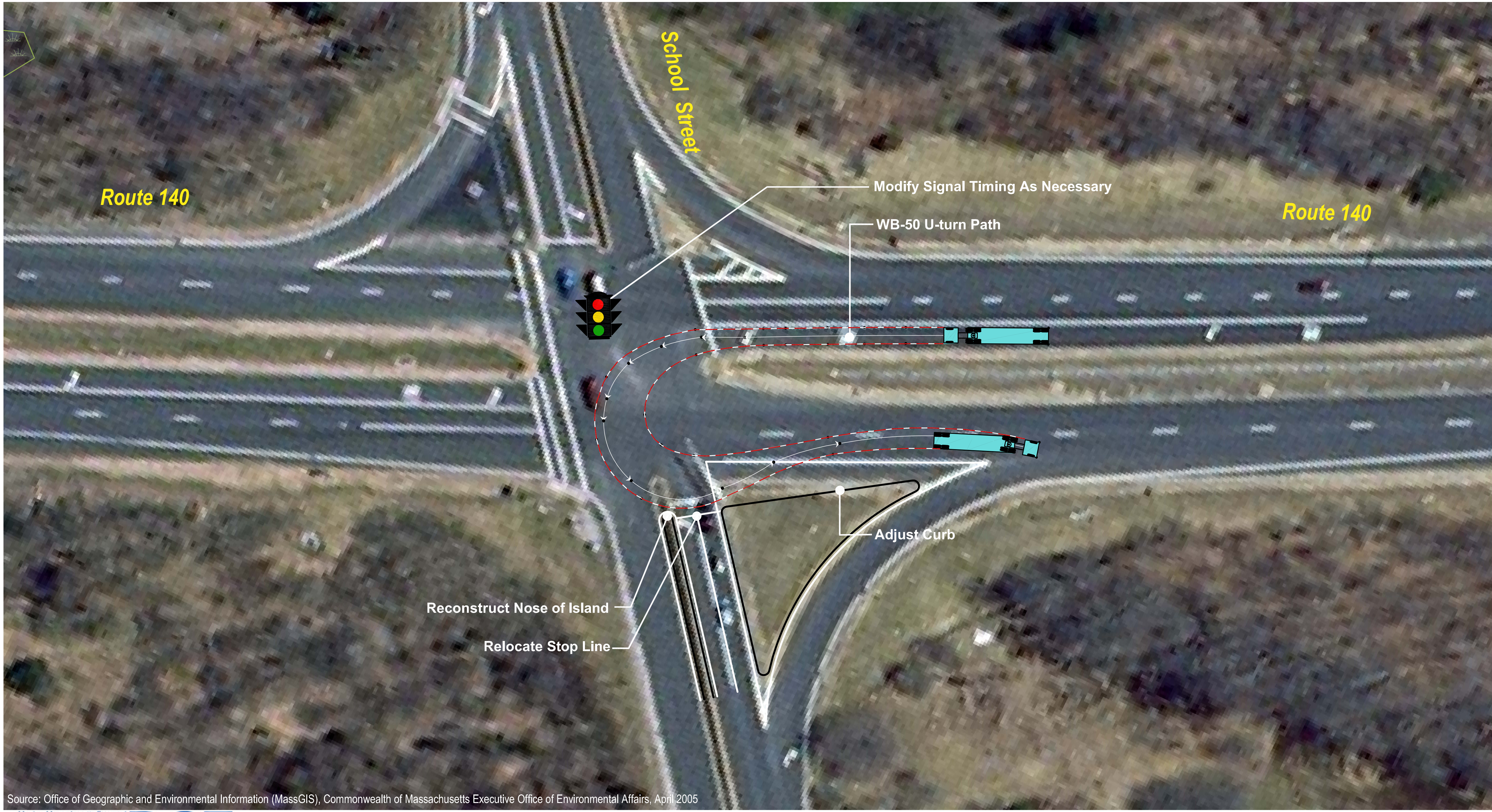
RAMP DESIGN	
MINIMUM DESIGN SPEED	35 FT
MIN RAMP WIDTH (SINGLE LANE)	22 FT
GRADE	0.5% - 6%
MAXIMUM SUPERELEVATION	6%
MINIMUM CURVE RADIUS	340 FT
VERTICAL CLEARANCE	16.5 FT
DECELERATION LENGTH	490 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.22

I-95 Exit 11 - Neponset Street
Long-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\I-495 Exit 11-12 School St -ST.dwg



Moving Massachusetts Forward. massDOT

Vanasse Hangen Brustlin, Inc.

Figure 5.23

I-495 Exit 11/12-School Street
Short-Term Alternative

Moving Massachusetts Forward massDOT

Legend

WETLAND

0 175 350 Feet

DESIGN CRITERIA

ROUTE 1 SOUTH TO I-495 NORTH	
ACCELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG ACCELERATION LENGTH	875 FT
REQUIRED ACCELERATION LENGTH	1350 FT

I-495 SOUTH TO ROUTE 1 SOUTH	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	25 MPH
EXISTNG DECELERATION LENGTH	335 FT
REQUIRED DECELERATION LENGTH	540 FT

WASHINGTON STREET ROUTE 1	
LANE WIDTH	11 FT
SHOULDER WIDTH	10 FT
MEDIAN SHOULDER WIDTH	2 FT
DESIGN SPEED	45 MPH
TAPER LENGTHS	500 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.24

I-495 Exit 14-Route 1 Short-Term Alternatives

Moving Massachusetts Forward. massDOT

0 75 150 Feet

Legend

WETLAND

DESIGN CRITERIA

I-495 NORTH TO ROUTE 1A	
DECELERATION LANE WIDTH	12 FT
SHOULDER WIDTH	12 FT
RAMP DESIGN SPEED	30 MPH
EXISTNG DECELERATION LENGTH	340 FT
REQUIRED DECELERATION LENGTH	520 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.25

I-495 Exit 15 - Route 1A
Short-Term Alternative

massDOT
Moving Massachusetts Forward.

0 50 100 FEET

Vanasse Hangen Brustlin, Inc.

Figure 5.26

Route 1 at Route 123
Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route1 at Route 1A Elmwood St - MT.dwg

Moving Massachusetts Forward. massDOT

Legend

WETLAND

0 50 100 Feet

Vanasse Hangen Brustlin, Inc.

Figure 5.27

Route 1 at Route 1A & Elmwood Street
Medium-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route1 at Main Street-ST.dwg

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward. massDOT

0 75 150 Feet

LEGEND

WETLAND

DESIGN CRITERIA

ROUTE 1	
DESIGN SPEED	45 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	4 FT
MEDIAN WIDTH	2 FT
LENGTH OF DECEL LANE	250 FT

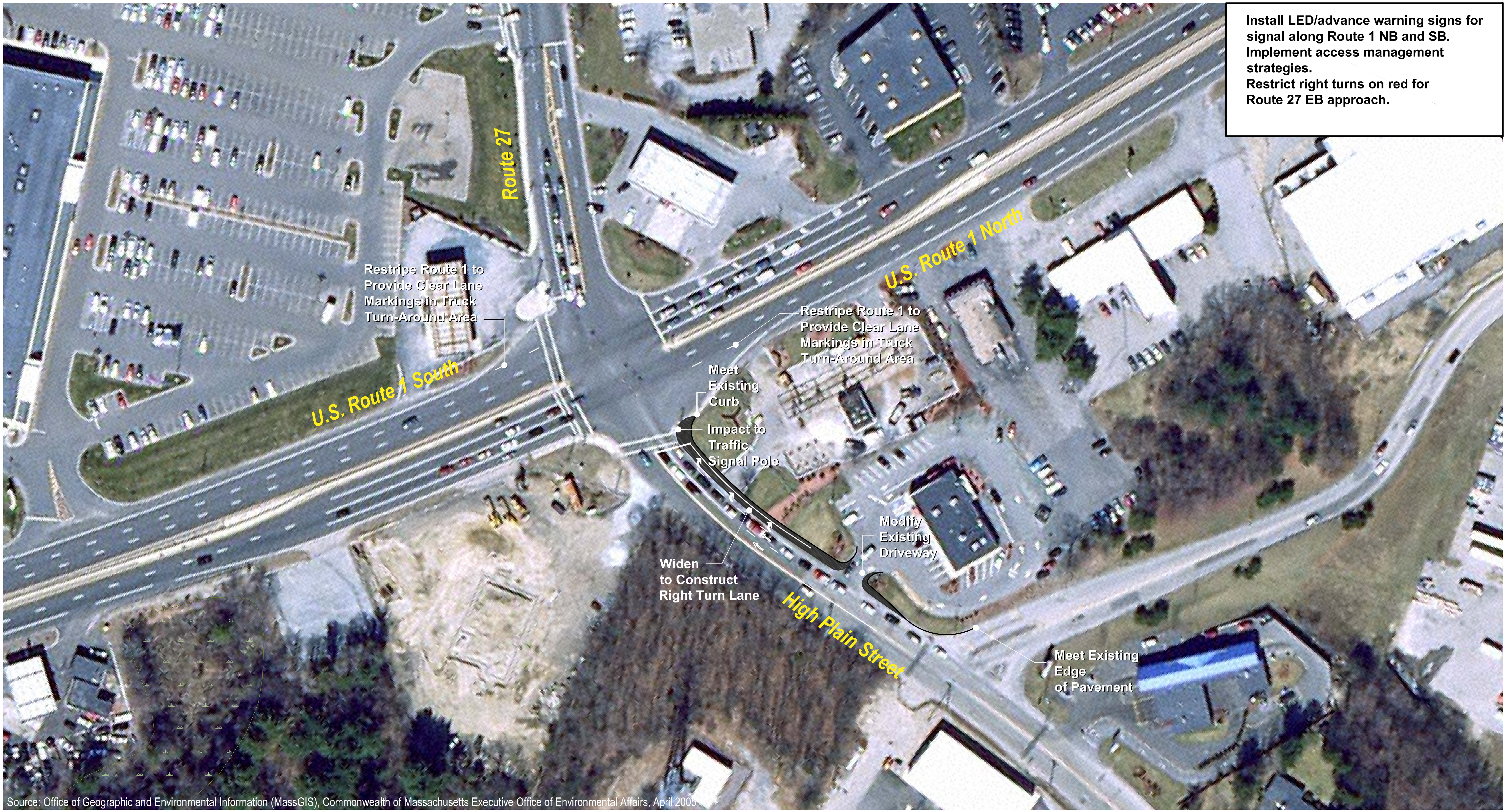
ACCEL/DECEL LANE WIDTH	11 FT
LENGTH OF ACCEL LANE	440 FT
MEDIAN TYPE	CONCRETE BARRIER
FUNCTIONAL CLASSIFICATION	URBAN PRINCIPAL ARTERIAL

Vanasse Hangen Brustlin, Inc.

Figure 5.28

Route 1 at Main Street
Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route 1 at Route 27.dwg



Moving Massachusetts Forward. massDOT

0 50 100 Feet

Legend

WETLAND

DESIGN CRITERIA

HIGH PLAIN STREET	
LANE WIDTH	12 FT
SHOULDER WIDTH	4 FT
LENGTH OF WB RIGHT TURN LANE	170 FT
WIDTH OF WB RIGHT TURN LANE	11 FT
FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL	

Vanasse Hangen Brustlin, Inc.

Figure 5.29

Route 1 at Route 27
Short-Term Alternative

\\vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route1 at Coney St.dwg

Vanasse Hangen Brustlin, Inc.

Figure 5.30

Route 1 at Coney Street
Short-Term Alternative

\\Vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route1 at Coney LT.dwg

Moving Massachusetts Forward. massDOT

0 50 100 Feet

Legend

WETLAND

TOWN BOUNDARY

DESIGN CRITERIA

MAINLINE	
DESIGN SPEED	45 MPH
LANE WIDTH	12 FT
SHOULDER WIDTH	4 FT
LENGTH OF SB LEFT TURN LANE	400 FT
FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL	

CONNEY STREET DESIGN CRITERIA	
LANE WIDTH	12 FT
SHOULDER WIDTH	4 FT
FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL	

Vanasse Hangen Brustlin, Inc.

Figure 5.31

Route 1 at Coney Street
Long-Term Alternative

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

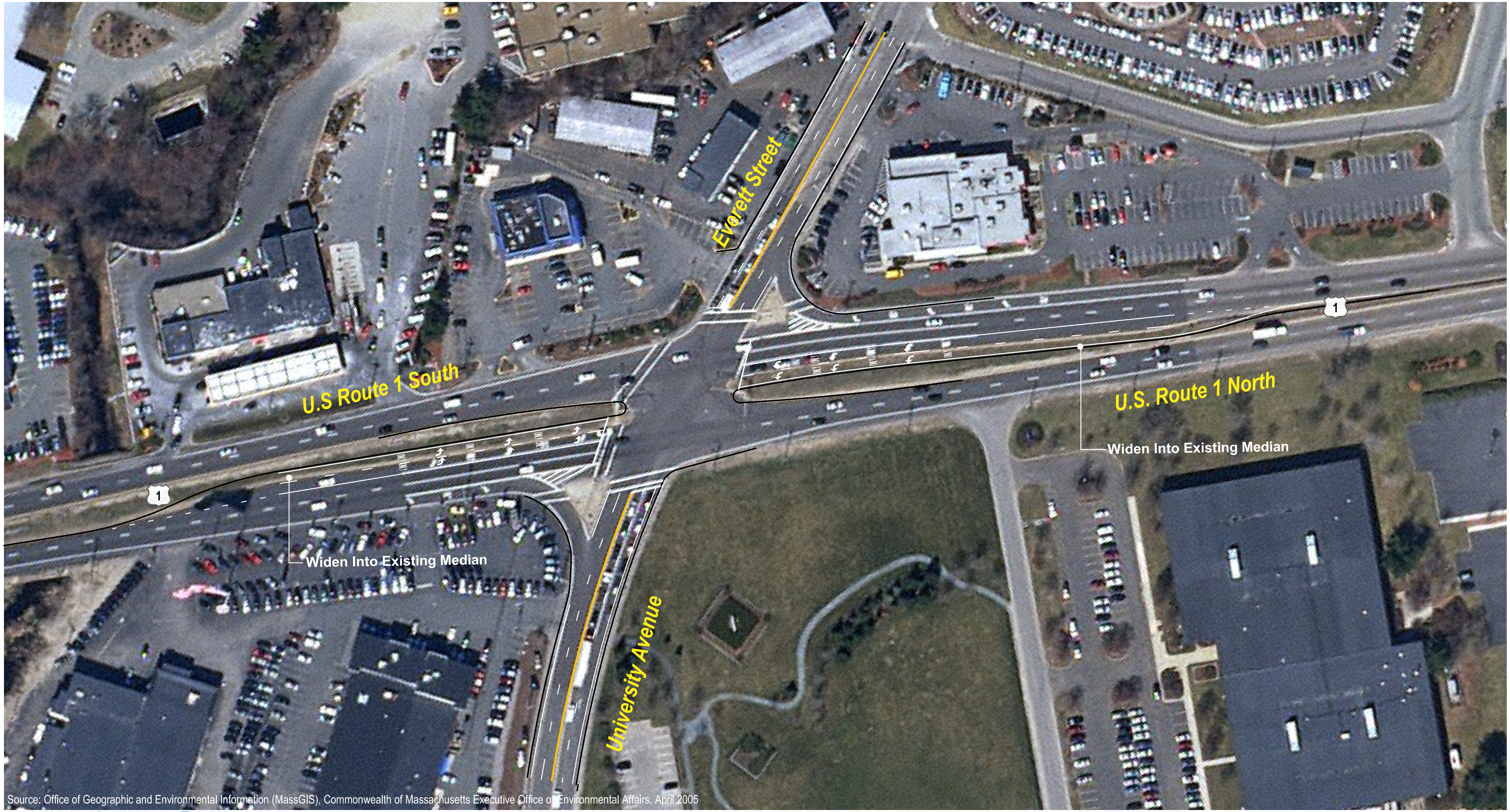
Moving Massachusetts Forward. massDOT

0 75 150 Feet

Vanasse Hangen Brustlin, Inc.

Figure 5.32

Route 1 at Dean Street
Short-Term Alternative



Moving Massachusetts Forward. massDOT

0 50 100 Feet

DESIGN CRITERIA

ROUTE 1 @ EVERETT STREET	
LENGTH OF TURN LANE	±170 FT
WIDTH OF TURN LANE	11 FT

Vanasse Hangen Brustlin, Inc.

Figure 5.33

Route 1 at Everett Street
Medium-Term Alternative

\\Vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route 1 at Everett Street-LT.dwg

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward. massDOT

0 75 150 Feet

DESIGN CRITERIA

ROUTE1	
DESIGN SPEED	45 MPH
LANE WIDTH	11 FT
SHOULDER WIDTH	4 FT
BRIDGE SPAN	200 FT
MAX GRADE	7%
VERTICAL CLEARANCE	14.5 FT

FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL

Vanasse Hangen Brustlin, Inc.

Figure 5.34

Route 1 at Everett Street
Long-Term Alternative

\\Vhb\proj\Wat-TS\10527.00\graphics\FIGURES\Route 1 at Elm Street-MT.dwg

0 75 150 Feet

DESIGN CRITERIA

ROUTE 1 @ ELM STREET	
LENGTH OF NB LEFT TURN LANE	300 FT
LENGTH OF SB LEFT TURN LANE	150 FT
WIDTH OF LEFT TURN LANES	11 MPH
SHOULDER WIDTH	4 FT
MEDIAN SHOULDER WIDTH	2 FT

FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL

Vanasse Hangen Brustlin, Inc.

Figure 5.35

Route 1 at Elm Street
Short-Term and
Medium-Term Alternatives

Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2005

Moving Massachusetts Forward massDOT

0 75 150 Feet

DESIGN CRITERIA

ROUTE 1	
LANE WIDTH	12 FT
SHOULDER WIDTH MINIMUM	4 FT

FUNCTIONAL CLASSIFICATION: PRINCIPAL ARTERIAL

WASHINGTON STREET	
LANE WIDTH	12 FT
SHOULDER WIDTH MINIMUM	4 FT

FUNCTIONAL CLASSIFICATION: URBAN PRINCIPAL ARTERIAL

Vanasse Hangen Brustlin, Inc.

Figure 5.36

Route 1 at Washington Street
Medium-Term Alternative